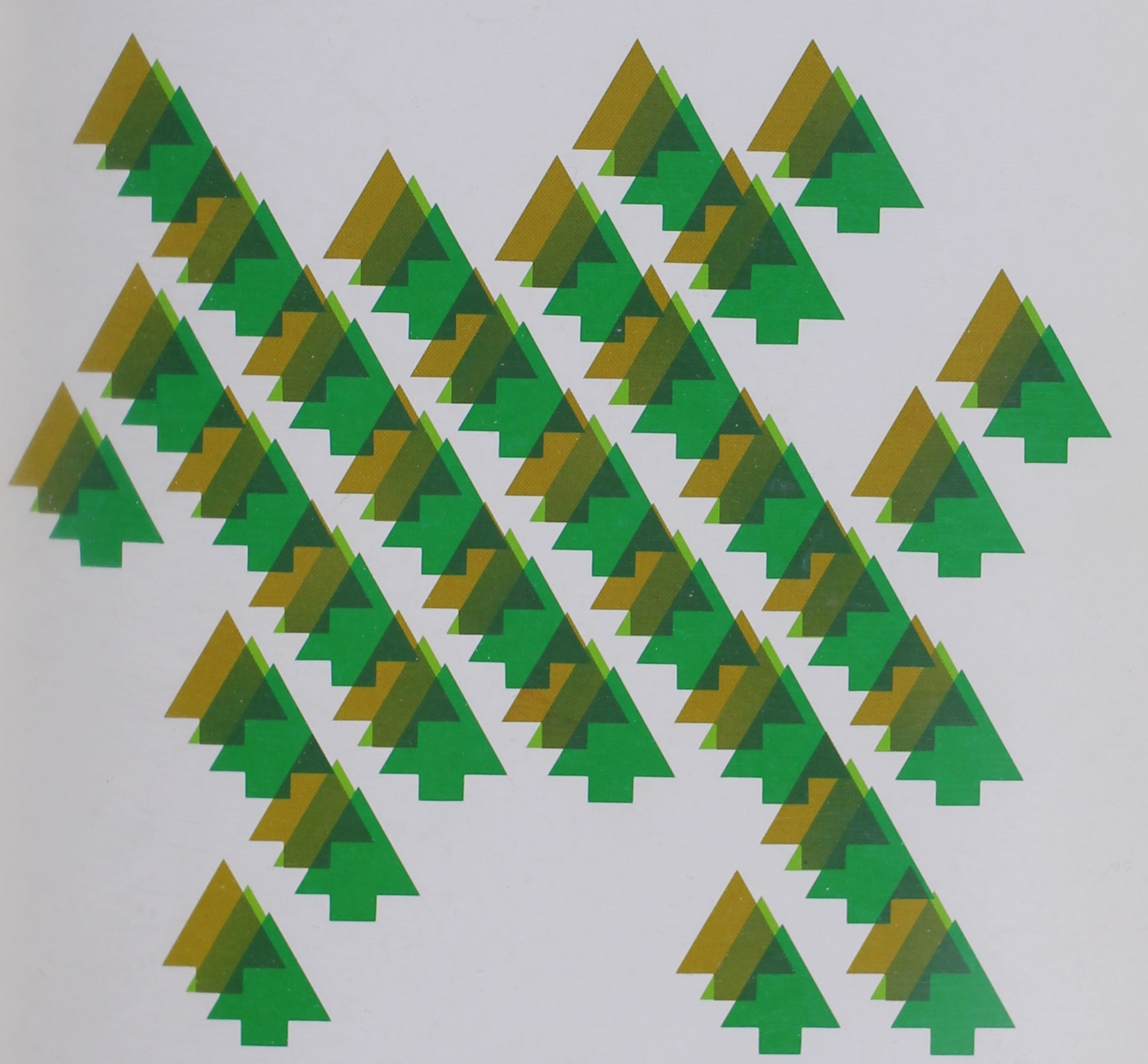
Forest Insect and Disease Conditions in the United States 1977



Forest Service

U.S. Department of Agriculture

THE NATIONAL FOREST SYSTEM

Foreword

This 27th annual report on forest insect and disease conditions was compiled by the Forest Insect and Disease Management staff, State and Private Forestry, Washington Office. It is made possible through the contributions of professional foresters, entomologists, pathologists, and technicians throughout the country. The report gives the reader a brief description of the status of forest insect and disease outbreaks on lands of all ownerships. The objective is to provide continuity, from 1 year to the next, of the trends of major forest insect and disease outbreaks.

A substantial part of the information comes to the entomologist and pathologist through many sources—the interested camper, tourist, and permittee—and a broad-based net of private, State, and Federal professional foresters and land managers. This is referred to in insect and disease management as a pest surveillance system. A surveillance system is essential in the early detection of pest outbreaks. Most of the information reported here is accumulated through systematic aerial and ground surveys designed to either detect outbreaks or to provide data for evaluating the biological potential of an outbreak. Detailed information on pest population trends is determined by evaluations of the critical life stages of the pest, its natural enemies, and the host itself.

Early detection and evaluation of insect infestations and disease infections have become increasingly important components of insect and disease management. A real opportunity exists to reduce the Nation's forest resource losses caused by insects and diseases; early detection is one means. In addition to reducing the estimated 9 billion board feet annual loss caused by insects and diseases, accurate and useful detection and evaluation data are essential to assist the land manager in making decisions affecting forest resource management. The critical nature of these decisions is emphasized when pesticides become necessary to deal with outbreaks.

The importance of detection and evaluation data has been clearly demonstrated by the tremendous infestations of the spruce budworms, gypsy moth, and mountain pine beetle in 1977. Not only is each of these infestations at or near the highest level ever recorded, but Federal, State, and private forest managers have expended more money and manpower during this period than at any comparable time in the past to deal with these problems. Control decisions are difficult to make because of economic and environmental considerations. The burden of these decisions can be eased by providing the needed detection and evaluation information to the decisionmaker.

Detailed reports on each insect or disease condition mentioned in this publication can be provided by the regional author(s). Persons desiring more details on these insect and disease conditions should contact the regional authors directly.

We acknowledge the assistance of all State and Federal cooperators who provided the information, and especially recognize the efforts of Oscar Dooling and Robert Acciavatti in compiling this report.

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This publication reports information involving pesticides. It does not contain recommendations for their use, nor does it imply the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

Common names of the insects discussed in this report are approved by the Entomological Society of America (ESA) or are widely accepted and commonly used. The ESA approved common names are indicated in the Insect Index. Scientific names of disease-causing agents are changed as additional studies are made. Recently approved new names in such cases are listed with the previously used names for the information and convenience of the reader.

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Forest Insect and Disease Conditions in the United States, 1977

Eastern Conditions

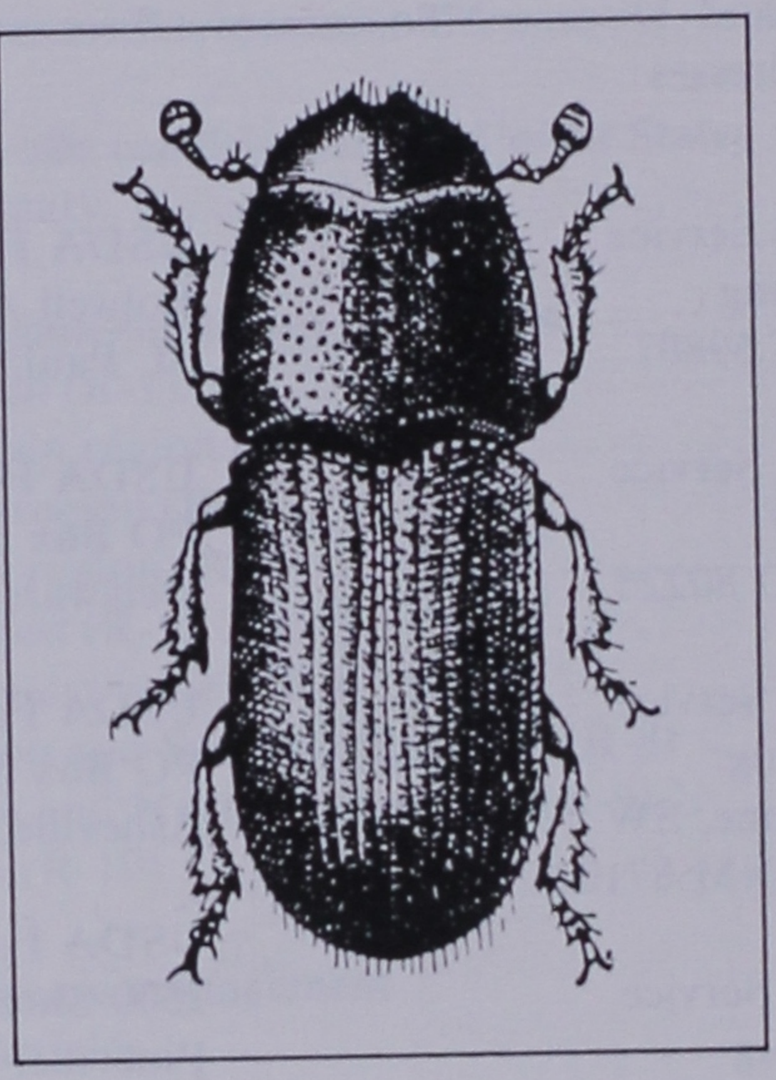
The spruce budworm, gypsy moth, fall cankerworm, and southern pine beetle again headed the list of insect pests in the Eastern United States. The spruce budworm defoliated about 7.7 million acres in the Northeastern and Lake States. Defoliation of 5.7 million acres of spruce-fir forests in Maine in 1976 prompted a suppression project on 930,000 acres this year. Gypsy moth populations increased dramatically, seriously defoliating 1.6 million acres.

Southern pine beetle infestations decreased to the lowest intensities in several years throughout most of the South, but severe tree killing continued in east Texas and Mississippi.

Fall cankerworm outbreaks severely defoliated almost 71,000 acres in North Carolina. Older infestations in Georgia expanded and intensified.

Nearly 638,000 acres were defoliated by the forest tent caterpillar in the tupelo forests of Alabama and Louisiana.

Other insects of note in the East were the oak leafroller, oak leaftier, oak sawflies, red pine scale, white pine weevil, pales weevil, balsam woolly aphid, and locust leaf miner.



Adult southern pine beetle, Dendroctonus frontalis.

Fusiform rust was the most widespread and serious disease of slash and loblolly pines in the South.

Pitch canker was found in every county in Florida and in localized areas from North Carolina to Louisiana. This disease occurred in plantations and seed orchards. Loblolly, slash, and shortleaf pines are the most susceptible.

Annosus root rot continued to cause losses on high hazard sites throughout the South, but predictions, made in the 1950's, of geometrically increasing losses have not materialized.

Seedling losses in southern nurseries continued, but soil fumigation prevented a repetition of 1976 conditions that resulted in the death of 15 million trees from one Florida nursery.

Dutch elm disease continued to spread and the intensity of damage increased. American elm is no longer a desirable candidate shade tree for planting in most eastern cities and towns because of this disease.

The European strain of scleroderris canker continued to kill 60- to 80-foot red pines on plantations in New York. This disease is now under quarantine regulations to prevent artificial spread of the European strain.

Other diseases of local concern included dwarf mistletoe on black spruce, wilts, diebacks, tip blights, and root declines.

Western Conditions

The western spruce budworm and the mountain pine beetle remained the insects of greatest concern in the forests of the Western United States. The western spruce budworm defoliated more than 6.5 million acres of Douglas-fir and true fir. Defoliation was most extensive throughout Montana, Idaho, eastern Washington, and Wyoming. Other infestations occurred in Colorado, New Mexico, Arizona, and Oregon. Many of these infestations increased in defoliation intensity from the previous year.

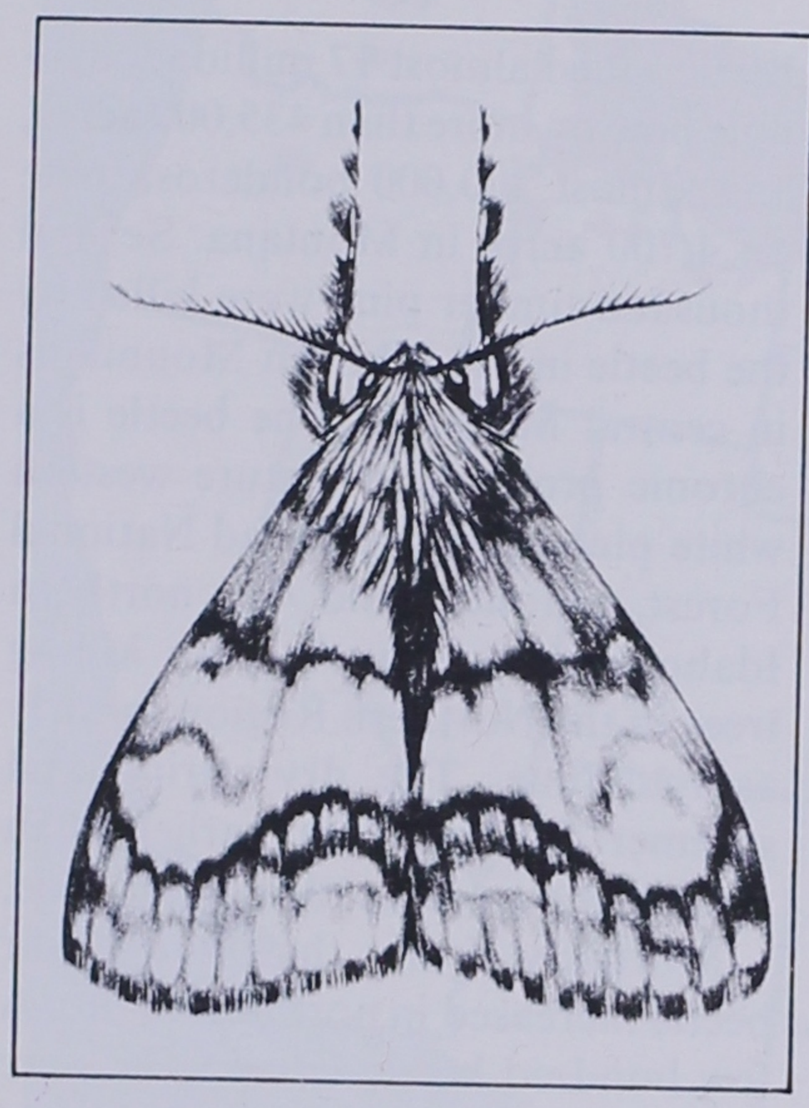
The mountain pine beetle killed lodgepole and ponderosa pines on nearly 4.2 million acres. The largest infestations were in western Montana, Yellowstone National Park, central Idaho, eastern Oregon, and the Black Hills of South Dakota. Infestations intensified greatly along the Colorado Front Range in Wyoming and Utah, and less intense

infestations were reported in California and northern Arizona.

Douglas-fir tussock moth infestations in northern New Mexico caused severe but local defoliation.

The first reported gypsy moth infestation in the Western United States was successfully suppressed south of San Jose, Calif., in 1976. No new infestations were found in the treated area.

Other insects causing increased tree mortality included the western pine beetle in California, Arizona, Idaho, and eastern Washington and Oregon. Douglas-fir beetle infestations increased significantly in northern Idaho, eastern Oregon, and Washington. Activity also increased in southern Idaho and Wyoming. Larch casebearer infestations increased in northern Idaho, western Montana, eastern Oregon, and eastern Washington. An eastern larch beetle infestation in interior Alaska expanded in size to over half a million acres. Severe drought in California and other western States predisposed many trees to insect attack.



Douglas-fir tussock moth.

Dwarf mistletoes are still the most destructive pathogens affecting conifers in the West. Heavy infections result in growth loss and tree mortality. A combination of dwarf mistletoe and comandra blister caused problems in the Rocky Mountain Region.

Dutch elm disease continues to spread west and poses a serious threat throughout the area. Seventeen States west of the Mississippi River have now reported the disease. It was detected in Washington for the first time in 1977.

Shoestring root rot, black-stain root disease, laminated root rot, and annosus root rot caused significant amounts of tree mortality in managed conifer stands throughout this area. Shoestring root rot centers as large as 300 acres were found in Montana. Black-stain root disease killed Douglas-fir throughout western Oregon and Washington. Laminated root rot has caused a growth impact of 400 to 500 million board feet in northern Idaho.

Needle diseases were more prevalent in the northern part of the West and Alaska this year than in previous years.

Root disease fungi killed seedlings in many western nurseries. Losses of 5 to 10 percent occurred in container-grown seedlings in Idaho.

Forest resources were damaged by air pollutants in some areas. Hydrogen fluoride, from an aluminum plant in northwestern Montana, injured vegetation on 20,000 to 30,000 acres near the smelter. Sulfur dioxide and heavy metal emissions from a copper smelter at Anaconda, Mont., continued; acidification of soils and damage to vegetation were evident on more than 300,000 acres of nearby forests.

Ohia decline is the major forest disease problem in Hawaii. Some 250,000 acres are affected.

This year's drought stressed trees in the central Rocky Mountains but not in the northern Rocky Mountains. Drought-caused damage was widespread in the Pacific Northwest. Severe drought conditions continued for a second year in northern California, further weakening trees and setting the stage for additional bark beetle outbreaks in 1978.

Forest Insect and Disease Conditions by Region

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Forest Insect and Disease Management
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Conditions in Brief

The western spruce budworm continues to be a major pest in Region 1; 3.7 million acres of defoliated stands on National Forest, other Federal, State, and private lands were visible from the air.

Larch casebearer populations increased this year and defoliated more than a half million acres of western larch.

Nearly 27,000 acres of western larch also were defoliated by the larch sawfly.

No Douglas-fir tussock moth-caused defoliation was detected.

Moderate defoliation of ponderosa pine by the pine butterfly occurred on 1,100 acres.

The forest tent caterpillar heavily defoliated quaking aspen on 195,000 acres in the Turtle Mountains, N. Dak.

A pine needle miner heavily defoliated nearly 10,000 acres of ponderosa pine type on the Flathead Indian Reservation and the Lolo National Forest, Mont. This was the first occurrence of this miner in the Region.

Spring and fall cankerworms annually defoliate Siberian elm in North Dakota shelterbelts. Many trees have died from this continuous defoliation.

The mountain pine cone beetle destroyed about 85 percent of the second-year western white pine cones in a Sandpoint, Idaho, seed orchard.

The mountain pine beetle was the major tree killer in Region 1. The beetle killed almost 17 million lodgepole pine on more than 435,000 acres, and almost 200,000 ponderosa pine on 4,700 acres in Montana. Several thousand limber pine were killed by the beetle in the Elkhorn Mountains in central Montana. The beetle is a chronic problem to mature western white pine on the Flathead National Forest, Mont., and in northern Idaho. Pine engravers were killing trees in the Northern Region as early as mid-June. The dry spring and summer favored this earlier than usual buildup of beetle populations.

Mortality from the Douglas-fir beetle increased in northern Idaho. A few hundred beetle-killed trees were found on the Helena National Forest, Mont.

Western balsam bark beetles killed more than 10,000 subalpine fir in scattered areas of the Rocky Mountains from northern Montana south to Yellowstone National Park, Wyo.

Several new areas of lodgepole pine with heavy comandra blister rust infection were found. An unidentified canker-causing fungus caused top dieback of Douglas-fir and true firs.

Root fungi did not cause much damage to bareroot nursery seedlings, but *Fusarium* spp. caused 5 to 10 percent losses in container-grown seedlings.

Nearly 2,000 high-risk hazard trees with butt and root rot were removed from recreation sites in Yellowstone National Park.

Dutch elm disease was found in Ravalli County, Mont., for the first time. The smaller European elm bark beetle was collected in several eastern Montana communities.

A survey of lodgepole pine stands near West Yellowstone, Mont., showed that large areas were free of dwarf mistletoe. Two cross-over infections of the lodgepole pine dwarf mistletoe on whitebark pine were found near West Yellowstone, Mont.

Laminated root rot is causing an annual growth impact of 400 to 500 million board feet in northern Idaho. Shoestring root rot is causing disease centers as large as 300 acres in central Montana. Annosus root rot is a potential problem associated with ponderosa pine killed by the bark beetle. Windthrown Douglas-fir seed trees with annosus-decayed roots were also found.

Needle diseases were more prevalent this year than in preceding years. Heavy infections of leaf rust caused early leaf fall in quaking aspen stands.

Fluorides emitted from an aluminum smelter have damaged several conifer species on 20,000 to 30,000 acres. Sulphur oxides, mercaptans, and hydrogen sulfides emitted from a pulp mill caused injury to Douglas-fir and ponderosa pine. Sulphur dioxide and heavy metals emitted from a copper smelter have damaged more than 300,000 acres of nearby ecosystems. Sulphur oxides and

fluorides emitted from coal-fired electric power generating plants in eastern Montana caused damage to ponderosa pine.

Despite dry conditions this year, no drought-related damage to trees was found.

Status of Insects

Western spruce budworm, *Choristoneura occidentalis* Free. The western spruce budworm epidemic continued in the Northern Region during 1977 (table 1). The defoliated area increased from 3.2 million acres in 1976 to 3.7 million acres in 1977. The increases occurred on 8 of the 13 National Forests and on the Flathead Indian Reservation. The defoliated area decreased on the remaining National Forests and the Yellowstone National Park. None of these infestations were suppressed during 1977.

Budworm egg mass surveys in 10 entomological units in the Northern Region indicated that defoliation would continue at about the same intensity during 1978. An entomological unit is an area where budworm populations could be managed relatively free from the influence of surrounding infestations.

Larch casebearer, *Coleophora laricella* (Hbn.) This insect defoliated 503,600 acres of host type throughout the Region (table 2).

Larch casebearer parasitism by native and introduced parasites was evaluated in northern Idaho and western Montana. Sampling was done at 103 sites where parasites had been released between 1967 and 1969, and at 28 additional locations near the release sites. Total parasitism averaged 22.9 percent on all sites. *Agathis pumila* (Ratz.) was collected at 73 of the sites and parasitism averaged 13.1 percent. Other parasites included *Chrysocharis laricinellae* (Ratz.), 8.8 percent; *Mesopoloebus* sp., 0.6 percent; and *Bracon pygmaeus* Prov., 0.4 percent.

Map 1—*Western spruce budworm infestations, 1977.*

Forest tent caterpillar, *Malacosoma disstria* Hbn. An infestation spread south from Canada in 1977 and heavily defoliated 195,000 acres of aspen throughout the Turtle Mountains in North Dakota. June sampling showed abundant larval parasitism and some disease. All areas sampled are expected to have only light defoliation in 1978.

Table 1.—*Extent of western spruce budworm defoliation by ownership in the Northern Region (R–1), in 1976–1977*

State, area, and ownership[2]	Acres of visible defoliation[1]	
	1976	1977
Northern Idaho		
Clearwater National Forest Area	358,070	286,407
Idaho Panhandle National Forests Area	190,591	176,454
Nezperce National Forest Area	107,050	184,315
Totals	655,711	647,176
Montana		
Beaverhead National Forest Area	250,427	173,250
Bitterroot National Forest Area[3]	413,641	451,495
Custer National Forest Area	5,155	7,370
Deerlodge National Forest Area	223,666	183,207
Flathead Indian Reservation	68,156	129,438
Flathead National Forest Area	99,801	54,527
Gallatin National Forest Area	286,325	427,990
Helena National Forest Area	313,161	462,979
Kootenai National Forest Area	9,685	20,029
Lewis & Clark National Forest Area	5,927	116,499
Lolo National Forest Area	820,330	947,941
Totals	2,496,274	2,974,725
Wyoming		
Yellowstone National Park	114,572	79,330
Regional Total	3,266,557	3,701,231

[1] Defoliation is visible when 25 percent or more of the current growth is damaged.
[2] Infested acreage for National Forests includes all Federal, State, and private lands within the Forest boundary.
[3] Partially in northern Idaho.

Northern tent caterpillar, *Malacosoma californicum pluviale* (Dyar). The first large outbreak of this insect reported in the Northern Region occurred in 1977 along the Pack River drainage and adjacent Sundance Fire area in northern Idaho. Deciduous trees and shrubs, especially willows, were heavily defoliated, but the defoliation may be beneficial if it releases planted conifers in the burned area. Abundant egg masses in late summer indicated the infestation may continue in 1978.

Mountain pine beetle, *Dendroctonus ponderosa* Hopk. Mountain pine beetle is the major tree killer in the Northern Region. Huge infestations have depleted lodgepole and ponderosa pine stands in Montana.

Lodgepole pine infestations. The most extensive infestation in the Region is on the Gallatin National Forest where more than 176,000 acres of forest land containing about 2.6 million killed trees, and 47,000 acres of other ownerships are infested. Tree mortality in the southwestern half of Yellowstone National Park decreased because most susceptible trees (those over 5 inches dbh) have been killed. However, tree killing persisted along the northwestern border near West Yellowstone, Mont., where millions of trees have been killed to date.

A second large infestation killed over 12 million lodgepole pines in 1977 on 142,900 acres along the west side of Glacier National Park from West Glacier north to the Canadian border. Another 26,900 acres are infested in the North Fork drainage of the Flathead National Forest adjacent to Glacier National Park. More than 1.5 million trees were killed there in 1977.

The third largest infestation in the Region encompasses the upper portions of the Yaak River drainage on the Kootenai National Forest. This infestation has remained about the same since 1976, with large concentrations of beetle-killed trees throughout more than 19,000 acres.

Several other large areas in Montana had abundant tree mortality in 1977: 9,700 acres in upper Jack Creek; thousands of acres within the West Fork Madison River drainage on the Beaverhead National Forest; thousands of acres southeast of St. Regis, Mont., along the Clark Fork River; and 13,700 acres in the Thompson River drainage on the Lolo National Forest where 383,800 trees were killed.

Increases in acres infested and numbers of trees killed are predicted in all areas in 1978.

Ponderosa pine infestations. The greatest number of trees were killed north and south of Lewistown, Mont., on thousands of acres of Federal, State, and private lands. This infestation has increased steadily during the past few years.

About 104,000 second-growth ponderosa pines were killed on 1,100 acres on Shook Mountain, Bitterroot National Forest, Mont. Over 2,200

trees were killed on 320 acres of the Rocky Boy Indian Reservation, Mont., and over 81,000 trees were killed on 3,400 acres on the Crow Indian Reservation, Mont.

Over a thousand trees were killed in each of the following areas in Montana: Little Rocky Mountains; south end of Rocky Boy Indian Reservation; southwest of Helena; Bitterroot Valley; Blackfoot Valley; along the Clark Fork Valley from Bearmouth to Frenchtown; and within the Fisher River-Pleasant Valley complex on the Kootenai National Forest. Additional tree killing is expected next year in Montana throughout the Clark Fork drainage near Missoula, the Bitterroot Valley, the Rocky Boy and Crow Indian Reservations, and on Federal, State, and private lands near Lewistown.

Table 2.—*Extent of larch casebearer defoliation in the Northern Region (R–1), 1977, by ownership*

(in thousand acres)

State and area	State and private lands	Federal lands	Total
Montana			
Flathead National Forest Area	23.2	56.6	79.8
Flathead Indian Reservation	0	27.6	27.6
Totals	23.2	84.2	107.4
Idaho			
Kaniksu National Forest Area	129.8	74.8	204.6
Coeur d'Alene National Forest Area	84.8	75.1	159.9
St. Joe National Forest Area	31.4	.3	31.7
Totals	246.0	150.2	396.2
Regional totals	269.2	234.4	503.6

Limber pine stands. Several thousand dead trees were detected in the Elkhorn Mountains west of Radersburg, Mont. This infestation has been active for several years, but will probably decrease soon due to depletion of host type.

Western white pine stands. Two chronic infestations remained on the Flathead National Forest, Mont. Hundreds of trees were killed around Hungry Horse Reservoir. The beetle has always been a chronic problem to mature white pine in northern Idaho and is still depleting remaining stands.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Many more groups of dying trees were observed this year than in 1976 in the northern Idaho forests. A few hundred trees were killed about 20 miles east of Coeur d'Alene, Idaho, and 600 to 700 trees were killed north of Wallace, Idaho, along Eagle and Prichard Creeks. On the Nezperce National Forest, Idaho, hundreds of trees were killed south of the Middle Fork Clearwater River and thousands were killed south of the Selway River from Lowell to Meadow Creek. Northwest of Priest River, Idaho, hundreds of dying trees were detected. A few hundred dead trees were observed on the Helena National Forest, Mont. Douglas-fir beetle infestations are predicted to expand and kill more trees in 1978.

Pine engravers, *Ips* spp. The dry spring and summer of 1977 favored increases of pine engraver populations in ponderosa pine stands. By mid-June, the first generation had emerged from trees attacked earlier in the year. Seldom do pine engravers kill trees this early in Region 1.

Thousands of ponderosa pines were killed throughout the Flathead Indian Reservation and along the Clark Fork and Lolo Creek drainages in Montana. Large pine engraver infestations are expected to continue there in 1978 as drought conditions persist in the ponderosa pine type.

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Lodgepole pine killed by the mountain pine beetle, Logger Creek, Mont.

Other Insects (R-1)

Insect	Host(s)	Localities	Remarks
A larch sawfly *Anoplonyx* sp.	Western larch	Kootenai National Forest, Mont.	Severely defoliated 16,800 acres
		Glacier National Park, Mont.	Severely defoliated 10,000 acres
		Flathead National Forest and Flathead Indian Reservation, Mont.	Small acreages severely defoliated
Douglas-fir tussock moth *Orgyia pseudotsugata* (McD.)	Douglas-fir, true firs	Montana and Idaho	Undetectable larval densities, a few males in pheromone traps
Pine butterfly *Neophasia menapia* (F. & F.)	Ponderosa pine	Flathead Indian Reservation, Mont.	Moderately defoliated 1,100 acres
A pine needle miner *Coleotechnites* sp.	Ponderosa pine	Flathead Indian Reservation, Mont.	Severely defoliated 9,900 acres
		Lolo National Forest, Mont. and Univ. of Montana Campus	Small acreages severely defoliated
Spring cankerworm *Paleacrita vernata* (Peck) Fall cankerworm *Alsophila pometeria* (Harr.)	Siberian and American elms	North Dakota	Severely defoliated shelterbelts and riverbank woodlands in many areas
A larch looper *Semiothisa sexmaculata* (Pack.)	Western larch	Thompson Falls, Mont.	2,000 acre infestation collapsed
Gouty pitch midge *Cecidomyia piniinopsis* O.S.	Ponderosa pine	Lochsa Reservation, Idaho	Scattered, severely infested saplings

Other Insects (R-1) *(Continued)*

Insect	Host(s)	Localities	Remarks
Mountain pine cone beetle *Conophthorus monticolae* Hopk.	Western white pine	Sandpoint, Idaho, seed orchard	Destroyed 85 percent of 2d year cones
Western balsam bark beetle *Dryocoetes confusus* Sw.	Subalpine fir	Middle, South, and North Fork Flathead River Canyons, Mont.	10,000 trees killed
		Beaverhead National Forest and lands near White Sulphur Springs and Lincoln, Mont., and Yellowstone National Park, Wyo.	Thousands of trees killed
Fir engraver *Scolytus ventralis* LeC.	True firs	Swan River and Swift Creek Canyons, Flathead National Forest, Mont.	Several hundred trees killed
Western pine beetle *Dendroctonus brevicomis* LeC.	Ponderosa pine	Clearwater River Canyon, Nezperce National Forest and Nezperce Indian Reservation, Idaho; and Pleasant Valley, Kootenai National Forest, and Flathead Indian Reservation, Mont.	Hundreds of mature trees killed

Status of Diseases

Several new areas of lodgepole pine with heavy *Cronartium comandrae* Pk. infection were found.

More dead trees, tops, branches of seedling and sapling Douglas-fir and true firs were found this year than in previous years. Damage resulted from stem infections of an unidentified canker-causing fungus, probably *Tympanis* sp. or *Scleroderris* sp.

Root fungi did not cause significant damage to bareroot nursery seedlings; but container seedling losses were as great as 5 to 10 percent. *Fusarium* spp. were the major fungi involved.

Topkilling of 2–0 bareroot western larch at the Coeur d'Alene Nursery was common this spring. Similar damage occurred on container-grown seedlings at several greenhouses. Damage was caused by *Botrytis cinerea* Pers. ex Fr.

Stem decays were associated with hazard trees in Glacier National Park campgrounds.

In Yellowstone National Park, nearly 2,000 high-risk hazard trees in developed recreation sites were removed. Most were removed because of butt and root decay caused by *Phellinus pini* (Thore ex Fr.) Pil. (= *Fomes pini* ([Brot.] Fr.) Karst.) and either *Coniophora puteana* (Schum. ex Fr.) Karst. or *Phaeolus schweinitzii* (Fr.) Pat. (= *Polyporus schweinitzii* Fr.).

Dutch elm disease, caused by *Ceratocystis ulmi* [Buism.] C. Mor., occurred in scattered locations in North Dakota and in two counties

F – 700465

Douglas-fir dwarf mistletoe brooms on Douglas-fir near Flathead Lake, Mont.

(Missoula and Ravalli) in western Montana. Surveys of several eastern Montana communities detected the presence of the smaller European elm bark beetle (*Scolytus multistriatus* [Marsham]), the principal vector of the disease. Six American elms with Dutch elm disease were cut on the University of Montana campus. The University is pursuing a vigorous sanitation program and in 2 years has lost 10 trees (8.5 percent of the elm population). All these trees were in two rows and probably root-grafted. Losses are expected to continue on the campus. Spread of the disease into areas where the beetle occurs is also expected.

Dwarf mistletoes (*Arceuthobium* spp.) are still one of the major groups of damaging organisms in Region 1. Control is accomplished in conjunction with normal timber management activities and is financed from timber funds.

Complete examination of about 1,500 acres of lodgepole pine on two areas near West Yellowstone, Mont., showed large areas of all-aged stands to be free of dwarf mistletoe. Based on this survey, the land manager has the option of maintaining this all-aged condition in these areas without considering dwarf mistletoe impact.

Lodgepole pine dwarf mistletoe, *A. americanum* Nutt. ex Engelm., was found infecting two whitebark pines near West Yellowstone, Mont. This cross-over infection is considered a rare occurrence.

Two existing root disease problems and one potential problem occurred in the Region.

Phellinus weirii (Murr.) Gilbertson (= **Poria weirii** (Murr.) Murr.), usually found in combination with one to six other decay fungi, causes root disease centers as large as 5 acres in grand fir and Douglas-fir in northern Idaho and western Montana. A survey of the Coeur d'Alene part of the Idaho Panhandle National Forest showed that these centers covered 5 to 7 percent of the commercial forest area. Occurrence of root disease centers is significantly correlated with soil type, habitat types, productivity, elevation, and aspect. Dynamics of root disease centers (spread rates, regeneration, survival, etc.) is not well understood, and an accurate impact cannot be determined. However, applying information from the above survey—annual margin-spread rates of about 1.5 feet found in the Pacific Northwest Region—and an assumption that regeneration will not reach merchantable size, an estimate of annual growth impact is 400 to 500 million board feet in northern Idaho. Additional loss due to *P. weirii* occurs in the grand fir type in western Montana.

Armillariella mellea (Vahl ex Fr.) Karst. (= *Armillaria mellea* (Vahl ex Fr.) Kumm.) is the cause of another

Armillariella mellea *disease centers several hundred acres in size are associated with specific vegetative and land types in central and western Montana.*

F—700466

root disease problem. Isolated root disease centers as large as 20 acres are present in western Montana. In central Montana, centers as large as 300 acres are associated with limestone soils. Root disease centers occupy about 10 percent of the forested acreage on these soils. Five to 10 percent of five conifer species in a campground on the Lewis & Clark National Forest were infected.

Fomitopsis annosa (Fr.) Karst. (= *Fomes annosus* (Fr.) Cke.) is a potential problem in Region 1. In western Montana, the fungus is associated with mature ponderosa pine killed by bark beetle. The fungus is also present in roots of Douglas-fir seed trees. Although direct tree killing has not occurred, trees with 60 to 70 percent of the roots decayed have been windthrown.

Spores are sometimes numerous enough in western Montana to colonize 70 to 90 percent of exposed pine discs.

Polyporus schweinitzii is present in many old-growth stands of Douglas-fir and western white pine. Losses are confined to isolated blowdown of old trees. This fungus may not be a problem in managed young stands.

Needle and leaf diseases were present this year in larger numbers and over a wider geographical range than in preceding years. *Lophodermella concolor* (Dearn.) Darker and *Scirrhia pini* Funk and A.K. Parker, were common on two- and three-needle pines. Infection was greatest in northern Idaho but extended into western and central Montana. *Lecanosticta* sp. caused significant defoliation of western white pine over much of its range. *Lophodermella arcuata* (Darker) Darker was present on whitebark and limber pines on the Lewis and Clark National Forest in central Montana.

Hypodermella laricis Tub. and *Meria laricis* Vuill., in conjunction with larch casebearer and larch sawfly feeding, caused needle discoloration of western larch on 45,000 acres.

F – 700465

Douglas-fir dwarf mistletoe brooms on Douglas-fir near Flathead Lake, Mont.

(Missoula and Ravalli) in western Montana. Surveys of several eastern Montana communities detected the presence of the smaller European elm bark beetle (*Scolytus multistriatus* [Marsham]), the principal vector of the disease. Six American elms with Dutch elm disease were cut on the University of Montana campus. The University is pursuing a vigorous sanitation program and in 2 years has lost 10 trees (8.5 percent of the elm population). All these trees were in two rows and probably root-grafted. Losses are expected to continue on the campus. Spread of the disease into areas where the beetle occurs is also expected.

Dwarf mistletoes (*Arceuthobium* spp.) are still one of the major groups of damaging organisms in Region 1. Control is accomplished in conjunction with normal timber management activities and is financed from timber funds.

Complete examination of about 1,500 acres of lodgepole pine on two areas near West Yellowstone, Mont., showed large areas of all-aged stands to be free of dwarf mistletoe. Based on this survey, the land manager has the option of maintaining this all-aged condition in these areas without considering dwarf mistletoe impact.

Lodgepole pine dwarf mistletoe, *A. americanum* Nutt. ex Engelm., was found infecting two whitebark pines near West Yellowstone, Mont. This cross-over infection is considered a rare occurrence.

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F—700467

Douglas-fir and lodgepole pine killed by fluoride pollution, Columbia Falls, Mont.

A fungus, tentatively identified as *Delphinella balsameae* (Waterm.) Mueller, caused tip dieback on true firs in northern Idaho. This was the first occurrence of *D. balsameae* in Idaho.

Pucciniastrum spp. were widespread on true firs. *Melampsora occidentalis* Jacks infected Douglas-fir in northwestern Montana.

Heavy infections of *Melampsora medusae* Thuem. caused early leaf fall in quaking aspen stands in many areas of western Montana and northern Idaho.

The aluminum smelter at Columbia Falls, Mont., emitted more than 4,000 pounds of fluoride per day and as much as 60 percent of some mixed conifer stands 5 miles downwind of the aluminum plant have been killed. Growth loss on living trees exceeds 35 percent. Lodgepole pine, western white pine, Douglas-fir, western redcedar, western hemlock, western larch, and ponderosa pine have been damaged on 20,000 to 30,000 acres of State, Federal, and private lands. Herbivores dependent on native vegetation are still being poisoned by fluorides. A foam-scrubbing system installed by the company failed, and it is now installing a new system to reduce fluoride emissions.

Sulphur oxides, mercaptans, and hydrogen sulfides emitted from a pulp mill caused injury to Douglas-fir and ponderosa pine near Missoula, Mont. The mill is expanding now and emissions may be increased in the near future.

Sulphur dioxide and heavy metals (lead, zinc, cadmium) emitted from a copper smelter at Anaconda, Mont., have damaged more than 300,000 acres of nearby ecosystems. Highly acid soils (pH 3–3.5) are a result of these emissions. Much of the area is barren of plant life and is eroding in massive quantities.

Sulphur oxides and fluorides emitted from two coal-fired electric power generating plants in eastern Montana have caused an increase in ponderosa pine needle death and other abnormal conditions in trees nearby. Two new power generating plants will be built in the same area, and damage to plant life is expected to increase.

Despite the dry conditions this year, no reports of dought-caused conifer injury or death were received, and no drought-caused damage was found in this year's aerial surveys or ground checking.

Rocky Mountain Region (R-2)[1]

David W. Johnson and Vernon L.M. Creasap
Forest Insect and Disease Management
State and Private Forestry
Lakewood, Colo.

Conditions in Brief

An intensive mountain pine beetle outbreak continued in the Black Hills of South Dakota and Wyoming, although fewer ponderosa pines were killed than in 1976. Mountain pine beetle populations continued their increase in the ponderosa pine type along the entire Front Range of Colorado and in the Bighorn Mountains, Wyo.

In the lodgepole pine type around Middle Park, Colo., mountain pine beetle populations continued the decline first reported in 1976. Only a few small scattered groups of fading pines were detected on the Medicine Bow National Forest, Wyo., but near Atlantic City, Wyo., and on the southern Shoshone National Forest, Wyo., tree losses were extensive.

Western spruce budworm defoliation was reported on all National Forests except the Black Hills and Nebraska.

Tent caterpillars defoliated large areas of deciduous trees and shrubs in southern Colorado.

A large infestation of the flocculent fir aphid was detected near Rifle, Colo.

Lodgepole pine dwarf mistletoe and comandra rust cause the most significant disease problems in the lodgepole pine forests in the Rocky Mountain Region. Recently developed management guidelines and computer yield simulation programs provided valuable tools for the land manager in evaluating stands for treatment. Shoestring root rot was common throughout Region 2; however, losses appear insignificant. Additional work is needed to define the damage caused by this disease in all forest types in the Region.

Diplodia tip blight was the most destructive disease of pines in Kansas and Nebraska. Diseases of eastern redcedar included phomopsis twig blight and kabatina tip dieback. Diseases of hardwoods in the Great Plains included heart-rot of green ash, a decline of hackberry and walnut, Russian-olive canker, Dutch elm disease, oak wilt, and verticillium wilt of maple and Russian-olive. Weather damage was reported as common in widely scattered areas on conifers and hardwoods. Low winter temperatures in 1976–77, coupled with drought during 1977, placed stress on vegetation throughout the Region. Nursery diseases, including pythium and fusarium root rots, gray mold, and phomopsis blight were present in several nurseries.

Several studies on ectomycorrhizal fungi were begun this year. Evaluations of their effectiveness will be available in 1978–79.

The addition of forest pest specialists to the State Foresters' staff (through the Cooperative Forest Pest Management Act) in Kansas (1977), Nebraska (1975), and South Dakota (1975) has resulted in increased attention to the survey and assessment of insect and disease pests throughout the Great Plains.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. The mountain pine beetle continued to kill ponderosa pines along the entire Front Range of Colorado, along the eastern slopes of the Bighorn Mountains, Wyo., and throughout most of the Black Hills of South Dakota and Wyoming.

An estimated 1,250,000 ponderosa pines were killed on all ownerships along the Colorado Front Range in 1977—a 25-percent increase over 1976 losses. About 17 percent of the 1976 infested trees were removed from the Colorado Front Range during 1976. Several thousand trees were infested in the Bighorn Mountains, Wyo., during 1977.

The mountain pine beetle killed nearly 350,000 ponderosa pines in the Black Hills during 1977—a 27-percent reduction from 1976 losses. Salvage logging and insecticide treatment of infested trees along with timber stand improvement work continued in the Black Hills, S. Dak. During 1977, 330,900 of the 1976 infested trees were burned, sprayed with ethylene dibromide, or salvage logged. The South Dakota Division of Forestry treated or salvaged 89,800 infested trees on 32,600 acres. The Wyoming Forestry Division treated 15,200 infested trees and the Black Hills National Forest removed 225,900 infested trees.

[1] Contributions for this report came from Kansas State University Cooperative Extension Service, South Dakota State Division of Forestry; University of Nebraska Institute of Agriculture and Natural Resources; and the Rocky Mountain Forest and Range Experiment Station.

F—700468

1 *Ponderosa pine killed by the mountain pine beetle near Gross Reservoir, Colo.*

2 *Mountain pine beetle,* Dendroctonus ponderosae *Hopk.*

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Lodgepole pine losses to the mountain pine beetle in Colorado continued. The decrease began in 1976. Suppression activities on the Medicine Bow National Forest, Wyo., reduced tree mortality to only a few small scattered groups.

Extensive lodgepole and limber pine mortality on the Shoshone National Forest continued at South Pass and Atlantic City, Wyo., and spread into adjacent stands. Almost 190,000 trees were infested during 1977.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Populations of this insect were light throughout Region 2. Scattered, small groups of spruce were killed on the Rio Grande, San Juan, Grand Mesa, Gunnsion, and

Map 2—*Infestations of the mountain pine beetle (all hosts), 1977.*

Uncompahgre National Forests, Colo. During the winter of 1976–77, some spruce blew down on the Routt and Arapaho and Roosevelt National Forests, Colo. Salvage of this blowdown is planned to reduce the potential for a spruce beetle buildup in these areas.

Western spruce budworm, *Choristoneura occidentalis* Free. This insect defoliated Douglas-fir, spruce, and true fir forests on all National Forests in the Region except the Black Hills and Nebraska. Aerial surveys indicated more than 650,000 acres were defoliated this year compared to 517,500 acres last year. Defoliation was most extensive on the Colorado National Forests.

Tent caterpillars, *Malacosoma* spp. Severe aspen defoliation by the western tent caterpillar, *Malacosoma californicum* Pack., occurred on the San Juan, Pike, and San Isabel National Forests, Colo. The eastern tent caterpillar, *M. americanum* (Fab.), and forest tent caterpillar, *M. disstria* Hbn., were reported at moderate to high population densities in South Dakota. Many broadleaf trees and shrubs on the Arapaho and Roosevelt National Forests, Colo., were heavily defoliated by the southwestern tent caterpillar and *M. incurvum discoloratum* (Neu.).

Other Insects (R-2)

Insect	Host(s)	Localities	Remarks
Douglas-fir beetle *Dendroctonus pseudotsugae* Hopk.	Douglas-fir	Pike National Forest and San Isabel National Forest, Colo.; BLM lands near Douglas Pass, Colo.	Scattered, small groups of trees killed
Western balsam bark beetle *Dryocoetes confusus* Sw.	Subalpine and white firs	Arapaho, Roosevelt, Routt, and San Juan National Forests and private lands within White River National Forest, Colo.; West Long Creek Canyon, Shoshone National Forest, Wyo.	Scattered small groups of trees killed
Pine engravers *Ips* spp.	Pinyon pine	Mesa Verde National Park, Colo.	Killing trees in association with black-stain root disease
Douglas-fir tussock moth *Orgyia pseudotsugata* (McD.)	Douglas-fir, true firs, spruce	Denver, Boulder, Colorado Springs, and Fort Collins, Colo.	Defoliated ornamental host trees; undetactable defoliation in forests, but a few males in pheromone trees
Fall webworm *Hyphantria cunea* (Drury)	Numerous deciduous trees and shrubs	Pike National Forest and San Isabel National Forest, Colo.; Clear Creek Canyon west of Golden, Colo.; Arkansas River and Oak Creek Canyons, west and south of Carson City, Colo.	Local, moderate defoliation
Mimosa webworm *Homadaula anisocentra* Myrk.	Numerous deciduous trees and shrubs	South Dakota	Shelterbelts and ornamentals moderately to severely defoliated
White fir needleminer *Epinotia meritana* Hein.	White fir	Private lands in Pass Creek Canyon, La Veta, Colo.	Moderate defoliation
Flocculent fir aphid *Cinara occidentalis* (Lav.)	Subalpine fir	White River National Forest and Bureau of Land Management lands near Rifle, Colo.	Intense feeding on 8,000 acres with some branch mortality
Zimmerman pine moth *Dioryctria zimmermani* (Grote)	Scots and Austrian pines	Nebraska	Severe damage to ornamental and shelterbelt trees in 29 counties

Status of Diseases

Dwarf mistletoe, *Arceuthobium americanum* Nutt. ex Engelm., is one of the more important diseases in lodgepole pine in Region 2. About 50 percent of all commercial lodgepole pine forests in the Region are infested. The disease is most damaging in partially cut stands where dwarf mistletoe was disregarded during harvesting. Infected residual trees provide for additional spread and intensification of the disease. Heavily infested stands have about half the volume and twice the mortality of noninfested stands on comparable sites.

Lodgepole pine dwarf mistletoe was collected for the first time on Engelmann spruce on East Mesa, Bighorn National Forest, Wyo. The cross over of *A. americanum* to spruce is rare.

Comandra blister rust, *Cronartium comandrae* Peck., is an important disease of lodgepole pine in the Region, especially in stands over 80 years old.

Comandra rust causes spike tops, growth loss, and mortality in pole- to sawtimber-size trees. The greatest concentration of rust infection and damage occurs along the north side of the upper Wind River drainage in the Shoshone National Forest, Wyo. The dilemma now facing the land manager, particularly for the Wind River District, is what to do with rust infected stands.

A numerical scheme for comandra rust rating (CRR), similar to the one for dwarf mistletoe, has recently been developed. Average estimates of the incidence and intensity (disease rating) of the rust are used in the yield program (RMYLD) to project the effect of the disease over the rotation age. Yield projections for infected stands are used to evaluate the biological and economical feasibility of various management treatments, and to set the priority of stands for treatment.

Data on comandra rust were collected on the Medicine Bow National Forest in conjunction with a survey for lodgepole pine dwarf mistletoe. A total of 197 variable radius plots were established along roaded areas on the Forest; 26.2 percent of the plots had infected trees, and of the trees on these plots, 17.4 percent were infected.

Shoestring root rot is caused by *Armillariella mellea* (Fr.) Karst. (= *Armillaria mellea* (Vahl ex Fr.) Kumm.). An evaluation of shoestring root rot was made in a 25-year-old lodgepole pine stand thinned in 1964. The stand was on Buckhorn Creek, Arapaho, and Roosevelt National Forests. The stand was first surveyed in 1959 and tree mortality (about 2 percent) due to shoestring root rot was present. In 1977, eighty-four 1- to 100-acre plots were examined. All trees over 3 feet tall were tallied. A total of 1,085 trees were examined and only 48 were killed by shoestring root rot. None of the dead trees would have been suitable crop trees, thus the loss was minimal. None of the disease centers were large enough to result in understocking of the stand.

Shoestring root rot caused mortality in the pinyon-juniper type on Bureau of Land Management and privately owned lands north of Cotopaxi, Colo. Several areas with pockets of dying and dead trees were evaluated in 1976. This year 20 to 30 acres of infected trees were found several miles away on Arkansas Mountain. This root disease was present throughout the pinyon-juniper type near Cotopaxi, and appeared to be the most common cause of mortality. The pine engraver, *Ips pini* (Say), was common in diseased trees.

F—700470

Adult tent caterpillar.

Diplodia tip blight, *Diplodia pinea* (Desm.) Kickx., the most destructive pine disease in Kansas, was found in 10 counties. Austrian pine was the most commonly damaged species, followed by ponderosa pine and Scots pine.

Ash heartrot, *Fomes fraxinophilus* (Peck) Sacc., has increased the last 15 years in windbreaks established during the Prairie States Forestry Project (1935–42). A survey to determine the geographic distribution and amount of green ash heartrot in Nebraska showed the fungus was present in 24 counties in about 5 percent of the trees examined in the middle and eastern counties, but occurrence in the west was much lower. Infection by this fungus results in increased wind breakage of affected trees.

Phomopis twig blight, *Phomopsis juniperovora* Hahn., is a serious problem in cedar and juniper plantings in Kansas. Diseased trees were found in 22 counties. This disease is

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Aspen defoliated by the caterpillar, Cumbres Pass, Colo.

considered a serious threat to shelterbelts planted during the 1930's.

Sirococcus tip blight, *Sirococcus strobilinus* Preuss., a disease of spruce new to the Midwest, was found in eight counties in Kansas. Tree losses were not determined; however, the disease may become widespread due to the increased planting of spruce.

Hackberry decline, cause unknown, symptoms appeared on one or several limbs in which the leaves became chlorotic with mosaic patterns similar to those caused by several viral diseases. A premature leaf drop occurred followed by dieback of branches. During a span of several years, almost all of the tree is affected. The disease was most prevalent in the central counties of Kansas and Bon Homme and Hanson Counties in South Dakota. Severity has increased for the past 3 years in Kansas.

Kabatina tip dieback, *Kabatina juniperi* Schneider & V. Arx., of eastern redcedar was found in these counties in Nebraska: Cass, Johnson, Fillmore, Lancaster, and Holt. The extent of damage caused by the fungus is unknown.

Russian-olive canker, caused by *Botryodiplodia theobromae* Pat., caused light damage in scattered areas throughout South Dakota. Another canker organism of Russian-olive, *Nectria cinnabarina* Tode ex Fr., was found in Harvey and Douglas Counties, Kans. Siberian elm canker, caused by *Botryodiplodia hypodermia* Sacc., was reported in seven counties in eastern and central Nebraska.

Western gall rust, caused by *Endocronartium harknessii* (J.P. Moore) Y. Hiratsuka, was found in several ornamental plantings of ponderosa pine in Rapid City, S. Dak.

Cytospora canker, caused by *Cytospora annularis* E. & S., was found on mountain ash in Ellis County, Kans. Another species, *C. chrysosperma* (Pers.) F., occurred on cottonwood in these Kansas counties: Butler, Ford, Geary, Harvey, Lowe, and Rush. Neither disease appeared to be serious.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor., was found for the first time in four counties of South Dakota: Faulk, Hyde, Jones, and Sully. Several communities in the southeast corner of the State reported decline of as much as 85 percent in the disease from previous years. In other communities, the number of diseased trees more than tripled from 1976. In the 29 towns reporting in eastern South Dakota, 5,101 cases of disease were identified

and the trees removed. In Kansas, the percentage of elm dying from the disease appears to be decreasing.

Oak wilt, *Ceratocystis fagacearum* (Bretz) Hunt., was found in Rice and Montgomery Counties, Kans., for the first time. Infection of residential trees occurred in Leavenworth, Johnson, and Pottawatomi Counties. The disease was suspected in several oak stands east of Sioux Falls, S. Dak.

Verticillium wilt, *Verticillium albo-atrum* Reinke & Berth. (= *V. dahliae* Kleb.), was found causing minor damage to maple and Russian-olive in Kansas and to maple in Wayne County, Neb.

Dothistroma needle blight, *Dothistroma pini* Hulb., of Austrian pine increased after several years of relatively light infection in eastern Kansas and Nebraska due to favorable moisture conditions during July, August, and September. The fungus damaged about 10 acres of Christmas trees in Geary County, Kan. Needle death and premature needle cast occurred on about 75 percent of the trees.

Blight of eastern redcedar, caused by *Cercospora sequoiae* var. *juniperi* E. & E., was found on 12- to 15-year-old trees near Pierre, S. Dak.

Brown-spot needle blight, caused by *Scirrhia acicola* (Dearn.) Sigg., infected Scots pine in parts of Kansas. Because of favorable moisture conditions, infection was greater this year than in previous years.

Decline of black walnut occurred in Clay County, S. Dak., and these counties in Nebraska: Burt, Cass, Cumming, Dakota, Dixon, Dodge, and Thurston. Affected trees showed crown dieback and epicormic branching. Cause of the decline was not determined. A spring freeze in May 1976, coupled with the extremely dry summer of 1976, may have been contributing factors.

Weather damage. Cottonwood dieback occurred in populated areas of Morris, Lyon, and Sedgwick Counties, Kans. Low winter temperatures of 1976–77 and other stress factors (excessive dry and wet periods) were likely involved.

Drought stress caused needle drop on blue spruce and Scots pine plantings throughout Kansas.

Leaf scorch due to high temperatures was found on various hardwoods in northern Kansas during July.

Nursery diseases. About 20 percent of 1–0 Engelmann spruce seedlings died at the Forest Service Mt. Sopris Tree Nursery, Carbondale, Colo., in beds that had been fumigated the previous fall with Dowfume® MC–33. *Fusarium* spp. were isolated from diseased seedlings but not confirmed as the primary cause of death.

Estimates of *Pythium* and *Fusarium* spp. populations in the soil were made at Mt. Sopris Tree Nursery and the South Dakota State Division of Forestry, Big Sioux Conifer Nursery, at Watertown, S. Dak. At Mt. Sopris, the pathogens and weeds were reduced below detectable levels in the top 6 inches of soil by fumigation with MC–33. In the future, fungal populations will be compared to disease incidence in order to predict losses and need for control.

Phomopsis blight was present on 2–0 and 1–0 eastern redcedar and Rocky Mountain juniper at the Forest Service Bessey Nursery, Halsey, Nebr., in mid-June. Infection was most severe at the margins of the 2–0 blocks and was light along the margin of one 1–0 block that was adjacent to a 2–0 block. Biweekly applications of Benomyl® begun in April and continued throughout the growing season prevented significant losses.

Ponderosa pine seedlings lifted from Bessey Nursery have been sampled every other year since 1971, held in a lath house for 2 to 3 years, and examined for symptoms of western gall rust. Seedlings collected in 1971, 1973, and 1975 had rust infection rates of only 0.0, 0.1, and 0.5 percent, respectively. The 1977 seedling sample will be examined in 1979.

Pine windbreaks near the nursery are rogued each year for galled trees to prevent infection of seedlings.

Gray mold, *Botrytis cinerea* Pers. ex Fr., caused significant mortality of container-grown lodgepole pine seedlings at the Colorado Hydroponics Nursery near Lyons, Colo. Conditions within the affected greenhouse were ideal for growth of the pathogen. Seedlings were so closely packed that little air movement occurred among the trees and the fungus built up at the base of the seedlings and killed trees in groups. Routine treatment with Benomyl was not effective in controlling the disease, but losses were reduced by removing infected seedlings and adding a detergent to fungicides for greater penetration and coverage of seedlings.

In 1976, container-grown ponderosa pine were inoculated with the mycorrhizal fungus, *Pisolithus tinctorius* (Pers.) Coker & Couch. The first group of outplanted seedlings died due to the drought. Another group was planted on the San Juan National Forest in 1977; survival will be checked in 1978.

Three types of inoculum were used on container-grown lodgepole pine and Engelmann spruce seedlings at the Mt. Sopris Tree Nursery: (1) partly decomposed sawdust, (2) forest duff, and (3) laboratory-grown

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[1] *Dwarf mistletoe brooms on lodgepole pines left during logging operations.*

[2] *Kabatina tip dieback on eastern redcedar.*

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P. tinctorius mycelium. These seedlings will be checked for mycorrhiza in 1978.

Four nurseries, Bessey Nursery, Mt. Sopris Tree Nursery, Big Sioux Conifer Nursery, and Colorado State Forest Service Nursery, Fort Collins, Colo., in Region 2, are part of a nationwide test of commercial (Abbott Laboratories) vegetative inoculum of *P. tinctorius*. This is a cooperative test by the Forest Service Institute of Mycorrhizal Research and the Southeastern Area, State and Private Forestry. *P. tinctorius* increases survival of outplanted pine on adverse sites in the Southeast.

The collection and identification of native mycorrhizal fungi in Colorado continued. Cultures collected in 1977 will be checked for growth in artificial culture.

Southwestern Region (R-3)[2]

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Conditions in Brief

The mountain pine beetle killed scattered trees and groups of trees on the Kaibab Plateau, Ariz., and widely scattered trees on the Carson and Santa Fe National Forests, N. Mex. The spruce beetle killed markedly fewer trees in the Jemez Mountains, Santa Fe National Forest, N. Mex., than in 1976. Tree mortality from the western pine beetle increased on the Kaibab and Tonto National Forests, Ariz. Widely scattered tree killing by the roundheaded pine beetle occurred on the Lincoln National Forest, N. Mex., and Coconino National Forest, Ariz., with the greatest losses on the Mescalero Apache Indian Reservation, N. Mex. Several pine engraver infestations killed large numbers of ponderosa pines in the Southwest. The most damaging infestations were on the Coconino, Gila, and Apache-Sitgreaves National Forests, Ariz.

The western spruce budworm defoliated about 198,000 acres of Douglas-fir and true firs. An operational spray project to evaluate the long-term effects of a single application of Sevin® 4 Oil against budworm populations during their build-up phase was conducted in 1977. The New Mexico fir looper defoliated about 500 acres of Douglas-fir and white fir on the Lincoln National Forest, N. Mex. The white fir needle miner caused light defoliation on the Apache-Sitgreaves National Forest, Ariz. The Douglas-fir tussock moth severely defoliated 2,500 acres of Douglas-fir and true fir regionwide. New infestation centers were detected on the Cibola National Forest and Nâmbe Indian Reservation, N. Mex. A ground application of insecticides and an aerial application of the Douglas-fir tussock moth pheromone were evaluated by the Douglas-fir Tussock Moth Research and Development Program personnel. The western tent caterpillar defoliated aspen stands throughout Region 3, with a particularly severe infestation on the Kaibab Plateau, Kaibab National Forest, Ariz.

Reduction of growth and tree mortality by dwarf mistletoes continued throughout southwestern forests. The simulated yield program (SWYLD2) was used to quantify dwarf mistletoe losses on nearly 20,000 acres of ponderosa pine type. Surveys to collect SWYLD2 input data were completed on 12 Ranger Districts in Arizona and New Mexico. Resource managers are now using simulated yield tables to aid in setting treatment priorities and developing management strategies for dwarf mistletoe-infested stands.

Southwestern dwarf mistletoe caused stand deterioration in campgrounds on several National Forests. A control project in the Horsethief Basin Recreation Area, Prescott National Forest, was started in 1977. Tree removal and pruning are being used to reduce adverse effects of dwarf mistletoe.

Combinations of two or three dwarf mistletoe species (Douglas-fir dwarf mistletoe on Douglas-fir, Apache dwarf mistletoe on southwestern white pine, and southwestern dwarf mistletoe on ponderosa pine) in one location caused growth loss and mortality of infested trees on the Apache-Sitgreaves and Cibola National Forests.

Root diseases caused localized losses at several locations in Arizona and New Mexico. Shoestring root rot killed trees in ponderosa pine plantations throughout the Region.

Limb rust of ponderosa pine killed branches of some trees at several locations in the Region. Spruce and fir broom rusts were present throughout the Southwest. A heavy infection of spruce broom rust on the North Rim in Grand Canyon National Park produced many spiketops in Engelmann spruce.

The cottonwood rust infected quaking aspen and cottonwood at several locations in Arizona and caused premature leaf drop.

Noninfectious diseases, such as salt damage, drought stress, and lightning strikes, killed some trees in localized areas throughout Arizona and New Mexico.

Pythium sp. and *Fusarium* sp. were found in all sampled parts of the Albuquerque Tree Nursery. Development of beds and soil fumigation should reduce fungal populations before the 1978 seeding.

Container-grown spruce seedlings in an Arizona nursery were damaged by basal stem cankers caused by high soil surface temperatures.

Trunk rot was prevalent on white fir in both forest stands and campgrounds throughout Arizona and New Mexico.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. This beetle continued to kill scattered ponderosa pines in Region 3. In Arizona, the infestation on the Kaibab Plateau—North Kaibab Ranger District, Kaibab National Forest, and the adjoining Grand Canyon National Park—remained at the same intensity as in 1976. Only scattered single trees or small groups of 2 to 10 trees were killed on about 100,000 acres. In New Mexico, widely scattered tree-killing

[2] Includes all forests in Arizona and New Mexico and National Park Service lands in western Texas.

F—700474

Saplings and poles killed by pine engravers, Ips *spp., in a thinning area.*

occurred on the Canjilon, El Rito, Jicarilla, Penasco, Taos, and Tres Piedras Ranger Districts, Carson National Forest, and on the Espanola and Jemez Ranger Districts, Sante Fe National Forest. No increase in infestations is expected in 1978.

Since all infestations were low, no direct suppression was recommended. Salvage logging was recommended on some Ranger Districts, but little of the timber was removed because of the high costs of logging scattered dead trees. Carson National Forest personnel indicated that many of the beetle-killed trees were used for fuelwood by the public. Aerial detection survey maps helped wood cutters locate areas of dead trees.

The third successful year of evaluating a mountain pine beetle trap-tree technique using recently cut ponderosa pine was completed. The small-scale evaluation was done in cooperation with the Rocky Mountain Forest and Range Experiment Station. A pilot project may be conducted in 1978 to evaluate this technique for reducing low-level, nonendemic mountain pine beetle infestations over a larger area.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). A 75,000-acre infestation in the highest plateaus and mesas of the Jemez Mountains, Santa Fe National Forest, N. Mex., decreased markedly in 1977. Personnel of the Cuba, Coyote, and Espanola Ranger Districts conducted sanitation and salvage timber sales of about 20.5 million board feet of infested and susceptible Engelmann spruce during the infestation.

Elsewhere, only small isolated groups of spruce beetle-killed trees were detected on the Apache-Sitgreaves and Coronado National Forests and the Fort Apache Indian Reservation.

Western pine beetle, *Dendroctonus brevicomis* LeC. Scattered ponderosa pines were killed by this bark beetle all over the Southwest. The tree losses were about the same as in 1976, except for an increase on the Chalender Ranger District, Kaibab National Forest, and the Globe Ranger District, Tonto National Forest, Ariz. Salvage of accessible concentrations of dying trees were recommended.

Roundheaded pine beetle, *Dendroctonus adjunctus* Blandf. This insect continued to kill ponderosa pines on the Lincoln National Forest and Mescalero Apache Indian Reservation, N. Mex., and Coconino National Forest, Ariz. Tree losses were widely scattered with the greatest losses in the upper part of Pine Tree Canyon, Mescalero Apache Indian Reservation. Pole-size trees are most commonly attacked by this insect. Opportunities for salvaging infested trees are limited because there are few markets in this area for pole-size material.

Pine engravers, *Ips* spp. Several infestations of these bark beetles killed ponderosa pines in the Southwest. The most damaging infestations were on the Flagstaff and Elden Ranger Districts, Coconino National Forest, Ariz.; Luna Ranger District, Gila National Forest, N. Mex.; and Springerville and Alpine River Ranger Districts, Apache-Sitgreaves National Forest, Ariz. Successive years of timber and fire management programs in ponderosa pine stands had created slash and weakened or killed trees which caused the infestations. Sapling and pole-size trees were attacked and killed in these stands.

A suppression project on the Springerville Ranger District killed beetle broods in infested slash. The

slash was either burned, chipped, or piled and covered with clear plastic to create lethal temperatures.

Regional entomologists have been working with resource managers to prevent outbreaks of pine engravers. Managers are encouraged to plan timber and fire activities which minimize slash or weakened trees year after year in a pine stand. The chances of an outbreak can be reduced by thinning and cutting from July through October, thereby creating dry slash unsuitable for beetle attack the next spring. Timely and thorough slash disposal programs are encouraged in many areas to prevent beetle buildups. Training sessions also are held to promote field surveillance and reporting by forest workers. Entomologists have participated in the preparation and review of management plans and environmental statements, thereby insuring adequate consideration is given to pine engraver prevention and suppression.

Western spruce budworm, *Choristoneura occidentalis* Free. Budworm infestations increased for the third consecutive year. Defoliation was visible over 197,800 acres in 1977, compared to 123,700 acres in 1976. Budworm populations reached epidemic proportions on the Kaibab Plateau, Kaibab National Forest, Ariz., and the Carson, Santa Fe, Cibola, and Gila National Forests, New Nex. Suppression was not recommended for any of these infestations. Egg mass densities increased in 1977 on most National Forests, and at least moderate defoliation is forecast for these in 1978.

An operational spray project was conducted in the Jemez Mountains, Santa Fe National Forest, N. Mex. The project evaluated long-term effects of a single application of Sevin® 4 oil on budworm populations during their buildup phase. Sevin® 4 oil was aerially applied—at 1 pound active ingredient per acre in one-half gallon of total formulation—to about 37,500 acres. As a check, a nearby area of similar size was not treated.

Population changes and the resulting tree damage will be measured for the next 3 to 5 years in both areas. In the first year, unadjusted larval mortality, due to natural control factors within the treated area, was 93.1 percent compared to 45.3 percent in the untreated check area. Douglas-fir and white fir defoliation was 26.4 percent and 37.0 percent in the treated area and 40.8 percent and 61.1 percent in the untreated check area. In the year of the spray project, 14.4 percent of the Douglas-fir foliage and 24.1 percent of the white fir foliage was preserved.

One of the helicopters used to apply the spray—a Lama 315B with an underslung bucket—performed unsatisfactorily on this project. The manual hookup for the bucket system also presented a safety hazard during loading.

Douglas-fir tussock moth, *Orgyia pseudotsugata* (McD.). Severe defoliation of Douglas-fir and white fir occurred on 2,500 acres regionwide. New outbreak centers were found on Sandia Ranger District, Cibola National Forest, and in Nambe Canyon, Nambe Indian Reservation, N. Mex. Infestations in Trigo Canyon and Canyon del Agua, Cibola National Forest, are declining and will continue this trend in 1978.

Larval populations decreased in Arizona and southern New Mexico, but continued to increase in Los Alamos, Pueblo, and Media Dia Canyons in northern New Mexico.

Several insecticides were tested against epidemic tussock moth populations in Medio Dia Canyon, Tesuque Ranger District, and Santa Fe National Forest, N. Mex., by Pacific Northwest Forest and Range Experiment Station and Region 2 entomologists associated with the Douglas-fir Tussock Moth Research and Development Program. Ground applications of Dimilin® 25 WP, Orthene® 75S, Sevin® 50 WP, Pyrocide Growers Spray®, and several formulations of *Bacillus thuringiensis* were evaluated. In August, the Douglas-fir tussock moth pheromone was applied aerially to 10 acres adjacent to the ground tests in Medio Dia Canyon by scientists from the Pacific Northwest Forest and Range Experiment Station, Corvallis, Oreg. All tests gave adequate suppression. A complete analysis of the results will be available in 1978.

Western tent caterpillar, *Malacosoma californicum* (Pack.). Severe defoliation of aspen stands occurred on the North Kaibab Ranger District, Ariz., in 1977. Egg mass populations are decreasing, however, and only light defoliation is predicted for 1978.

Defoliation also was visible on the Apache-Sitgreaves National Forest and Fort Apache Indian Reservation, Ariz.; the Santa Fe, Carson, and Gila National Forests; Bandelier National Monument; and Santa Clara Indian Reservation, N. Mex.

Tent caterpillar infestations usually persist for 2 to 3 years and quickly decline. The defoliation and subsequent damage in affected stands rarely reach a point where control is needed. Though branch mortality can be excessive, little tree mortality occurs.

Other Insects (R-3)

Insect	Host(s)	Localities	Remarks
New Mexico fir looper *Galenara consimilis* Hein.	Douglas-fir and white fir	Bonito Creek Canyon, Lincoln National Forest, N. Mex.	Complete defoliation of 500 acres
White fir needle miner *Epinotia meritana* Hein.	White fir	Alpine and Springerville Ranger Districts, Apache-Sitgreaves National Forest, Ariz.	Several moderately defoliated areas

Status of Diseases

Dwarf mistletoes cause annual timber volume losses in the Southwest nearly equal to the annual allowable cut. The most damaging species are: southwestern dwarf mistletoe, *Arceuthobium vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. and Wiens; Douglas-fir dwarf mistletoe, *A. douglasii* Engelm.; western spruce dwarf mistletoe, *A. microcarpum* (Engelm.) Hawks. and Wiens; and Apache dwarf mistletoe, *A. apachecum* Hawks.

A new survey procedure for collecting input data for the simulated yield program (SWYLD2) and a data summary program (SWSUMMARY) were designed and tested. The SWSUMMARY program prepares stand summary tables and calculates SWYLD2 stand condition variables from survey data. Information provided by SWYLD2 simulated yield tables aids the resource manager in management of dwarf mistletoe-infested stands.

Southwestern dwarf mistletoe caused stand deterioration in campgrounds on the Coconino, Kaibab, and Prescott National Forests. Specific control recommendations were developed for each campground. A mistletoe control project was begun in the Horsethief Basin Recreation Area, Prescott National Forest. All trees with dwarf mistletoe ratings of three and higher (six-class rating system) were marked for removal in three campgrounds and the adjacent travel influence zone. Lightly infected trees in the campgrounds will be pruned to slow the increase of mistletoe in those trees.

The occurrence of several species of dwarf mistletoe in one area caused substantial losses in mixed conifer type on Alpine Ranger District, Apache-Sitgreaves National Forest, and Magdalena Ranger District, Cibola National Forest. The species involved were southwestern dwarf mistletoe, Douglas-fir dwarf mistletoe, and Apache dwarf mistletoe. Removal of class three and higher trees was recommended.

Spittlebugs fed upon southwestern dwarf mistletoe plants in several locations on the Apache-Sitgreaves National Forest killing some aerial shoots, but the effects were local.

Armillariella mellea (Vahl ex Fr.) Karst. (= *Armillaria mellea* (Vahl ex. Fr.) Kumm.) killed ponderosa pine in plantations throughout Region 3. The greatest losses were in plantations on the Santa Fe National Forest. This root rot usually acts as a natural thinning agent, but becomes a problem in plantations and other areas where trees are under stress.

Phaeolus schweinitzii (Fr.) Pat. (= *Polyporus schweinitzii* Fr.) was associated with windthrow of ponderosa pine in a campground on the Coconino National Forest. Removal of infected trees and stumps was recommended to reduce safety hazard for campground users.

Limb rust, caused by *Peridermium filamentosum* Pk., resulted in some branch and tree death in ponderosa pine sawtimber on the Coconino, Gila, Kaibab, and Santa Fe National Forests. Ponderosa pine in Grand Canyon National Park was also infected. Limb rust, in combination with twig borers, killed branches of trees in ponderosa pine sapling stands on the Kaibab National Forest. This occurrence is unusual because the disease usually infects larger ponderosa pine.

Spruce broom rust, caused by *Chrysomyxa arctostaphyli* Diet., was present in most spruce-fir forests of the Southwest. Some trees had been killed and other trees were top killed in an intense infection center on the North Rim of the Grand Canyon in Grand Canyon National Park.

Fir broom rust, caused by *Melampsorella caryophyllacearum* Schroet., intensified in white fir

throughout the Region. Resource managers have expressed concern about management of this disease. Fir broom rust infections increased markedly in the Sandia Mountains, east of Albuquerque, N. Mex.

Cottonwood rust, caused by *Melampsora* sp., infected cottonwood at several locations on the Apache-Sitgreaves National Forest, but did not kill any trees.

Douglas-fir, ponderosa pine, and white fir were killed or injured where highway deicing salt had run off the roads on the Cibola and Santa Fe National Forests and along New Mexico Highway 4, near Bandelier National Monument.

Many lightning-struck trees on the Kaibab National Forest and Grand Canyon National Park had dead or dying tops; other trees were broken off lower in the crown. The damaged trees had been attacked by a number of beetles and borers.

Drought stress was not a significant factor in the Southwest.

Foliage diseases were present throughout the Southwest, but caused little damage.

Before nursery beds were developed at the Albuquerque Tree Nursery, a survey showed that *Pythium* spp. and *Fusarium* spp. were present in 20 soil samples. Fungal populations ranged from: low (*Pythium* = 1.6 prop./g.; *Fusarium* = 240 prop./g.) to high (*Pythium* = 101.2 prop./g.; *Fusarium* = 7,120 prop./g.) throughout the nursery site. Pathogen populations within this range have killed significant numbers of seedlings in other Regions. Development of beds and fumigation of the soil will reduce fungi populations before 1978 seeding operations.

Container-grown spruce seedlings from the Bureau of Indian Affairs Nursery at McNary, Ariz., were damaged by a basal stem canker caused by high surface soil temperatures. Control recommendations included shading of seedlings and north-south orientation of rows.

Green algae built up at the Southwestern Handicapped Services Nursery near Silver City, N. Mex., because of improper irrigation practices and high temperatures. An algicide was recommended to correct the problem.

Echinodontium tinctorium (E. & E.) E. & E., was common on white fir on the Apache-Sitgreaves, Carson, Cibola, and Kaibab National Forests. This heart rot was also present in campgrounds on the Kaibab and Santa Fe National Forests. Removal of infected trees in the campgrounds to reduce the hazard to campers was recommended.

Other trunk rots occurred throughout Region 3, but were not considered significant.

F—700460

A mass of spittlebug spittle on a southwestern dwarf mistletoe plant, Apache-Sitgreaves National Forest, Ariz.

Work continued on a cooperative study (Region 2 and Rocky Mountain Forest and Range Experiment Station) to determine pathological effects of various logging practices on residual quaking aspen. After logging, mortality ranged from 0 to 21 percent of the tree's basal area on the 11 study plots in New Mexico and Colorado. Primary causes of mortality were *Cenangium signulare* (Rehm.) Davids. & Cash., *Ceratocystis fimbriata* Ell. & Halst., windthrow, and sunscald. A final evaluation of the plots will be made in 1979–80.

Premature leaf drop, resulting from infection by *Melampsora* sp., defoliated aspen in one location on the Kaibab National Forest. Aspen in several locations on the Fort Apache Indian Reservation were infected with *Marssonina populi* (Lib.) Magn. This disease also caused premature leaf drop and severe defoliation in one area.

Intermountain Region (R-4)[3]

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Conditions in Brief

The incidence of mountain pine beetle damage generally continued the slow decrease of 1976, but local infestations killed many trees on the Caribou, Boise, Payette, Sawtooth, and Targhee National Forests, Idaho. Tree killing persisted on the Ashley and Wasatch National Forests, Utah, and on the Bridger-Teton National Forest, Wyo.

Tree mortality from Douglas-fir beetle decreased on all Forests except for local areas on the Boise, Payette, and Salmon National Forests, Idaho. Pine engravers and western and mountain pine beetles worked together to kill groups of ponderosa pines over a wide area on the Boise and Payette National Forests, Idaho.

Western spruce budworm infestations in Idaho increased on the Boise, Challis, and Salmon National Forests, but decreased slightly on the Payette National Forest. A new infestation was detected in Grand Teton National Park, Wyo.

The major diseases were the stem decays, root rots, and dwarf mistletoes. The forest disease conditions have not changed from 1976.

F—700461

Active mountain pine beetle, Buffalo River, Targhee National Forest, Idaho.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk.

Lodgepole pine infestations. The mountain pine beetle again was the most damaging insect in the Intermountain Region. Although decreasing trends were noted on most Forests, several infestations remained throughout Region 4. In the Island Park area of the Targhee National Forest, Idaho, mortality dropped from 30 trees per acre in 1976 to 19 trees per acre this year. The current infestation has killed 75 or more trees per acre. Elsewhere on the Targhee National Forest only scattered mortality occurred. A slight increase in tree killing occurred on the Caribou National Forest, Idaho.

Tree mortality continued in many areas on the Ashley and Wasatch National Forests, Utah, and the Bridger-Teton Forest, Wyo. On the Ashley National Forest stands near Greendale Junction, in Rock Creek, Uinta River, Browne Canyon, and on the Taylor Mountain Plateau there was less mortality than last year. The most extensive area of mortality on the Ashley National Forest occurred on the north slope from the western boundary of the Forest east to Deep Creek. Losses on the Bridger-Teton Forest occurred in the canyons of Greys River, Hams Fork, Salt River, Pilgrim Creek, Black Rock, and Gros Ventre River, Big Sandy, Little Sandy, and Clear Creeks.

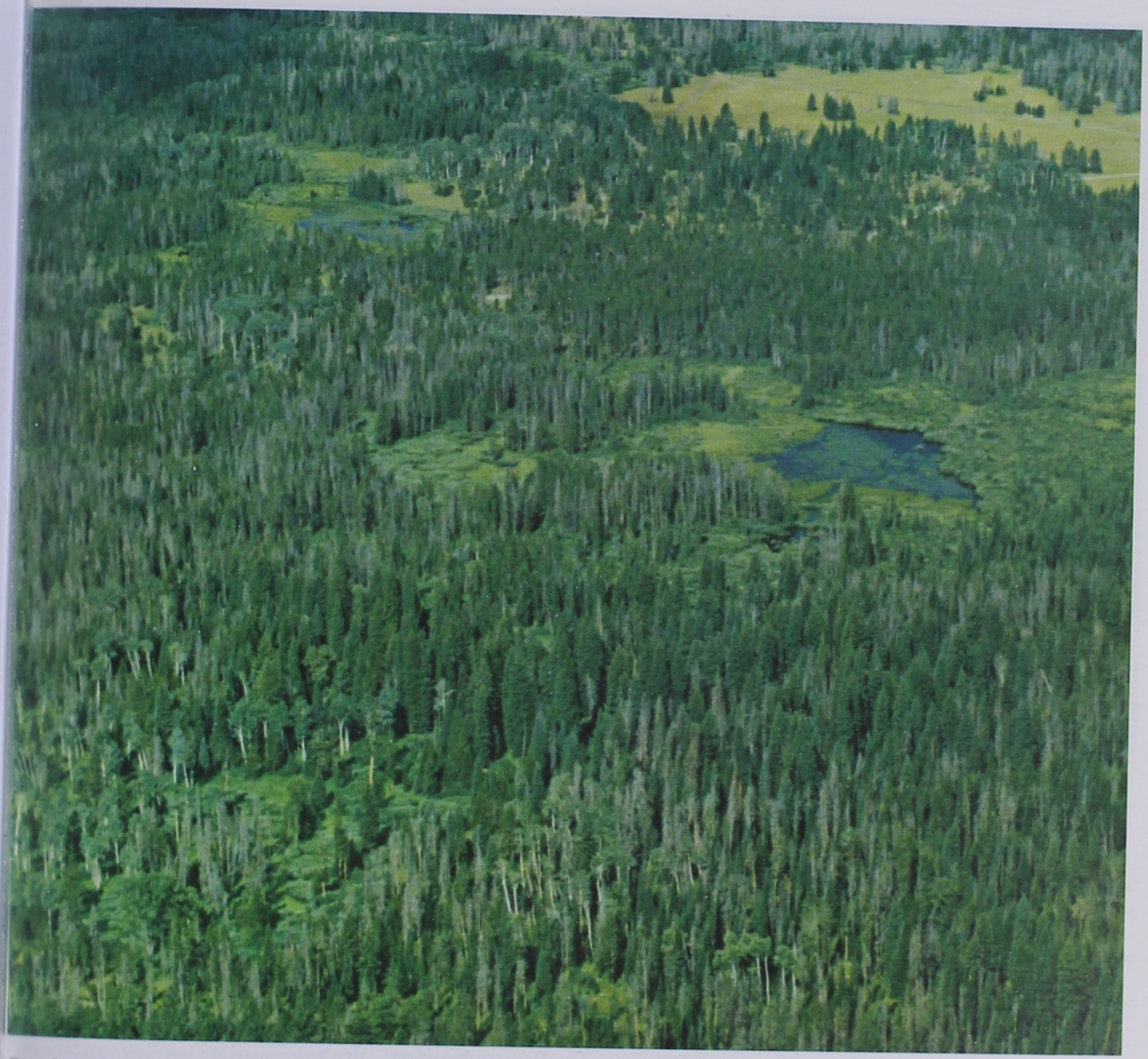
The decreasing trend in tree mortality on the Cassia Division, Sawtooth National Forest, Idaho, continued into 1977. In 1975, 20 million board feet of lodgepole pines were killed. In 1976, this figure dropped to 4.4 million board feet and this year it dropped again to 0.8 million board feet. About 389 million board feet have been killed on the Cassia Division by this infestation. Elsewhere on the Sawtooth National Forest, mountain pine beetle outbreaks in the headwaters of the South Fork of the Boise River killed an estimated 8,500 trees. On the Albion Division of the Sawtooth National Forest, about 4,000 trees were killed along the Big Wood River and Warm Springs drainages, west of Ketchum, Idaho.

On the Payette National Forest, Idaho, two large infestations continued at about the same intensity as last year. Five thousand trees were killed in the Paddy Flat area of Donnelly, Idaho, and another 4,500 trees were killed in the Johnson Park area west of Council, Idaho.

For the past 17 years, a mountain pine beetle infestation from Payette Lake to Cascade Reservoir on State, Federal, and private lands has depleted a considerable amount of the pine host type in west-central Idaho. Around the town of McCall, Idaho, southward to Cascade, Idaho, an estimated 50,000 lodgepole pines have been killed by this infestation. Scattered mortality continues along the North Fork of the Boise River and near Atlanta, Idaho, on the Boise National Forest.

Ponderosa pine infestations. Scattered tree mortality was recorded on the Boise and Payette National Forests, Idaho. The largest concentrations of mortality occurred on private lands east and northeast of

[3] Includes forests in Utah, Nevada, southern Idaho, western Wyoming, and eastern California.



Standing dead lodgepole pine, typical of areas where the mountain pine beetle outbreaks have collapsed.

F—700462

, Cascade, Idaho, with a small amount north of Crawford Ranger Station, Boise National Forest. An estimated 2,000 trees faded in 1977. The mountain pine beetle is active in second-growth and mature ponderosa pine stands around the perimeter of Payette Lake eastward toward Little Payette Lake near McCall, Idaho. This infestation has killed about 12,000 trees thus far and has the potential to continue at a high intensity because of abundant host type.

Pilot projects to evaluate the effectiveness of selected insecticides as preventive sprays against mountain pine beetle attack were continued. Testing began in June 1976 on the Targhee National Forest, Idaho, using Sevimol–4®, Isotox lindane, and Dursban®. The insecticides were applied to lodgepole pines

F—700475

Douglas-firs killed by the Douglas-fir beetle, Boise National Forest, Idaho.

as 2 percent (active ingredient by weight) water-based sprays. Sevimol–4® reduced attacks by 99 percent, Isotox lindane by 74 percent, and Dursban by 23 percent. In 1977, Sevimol–4® was again tested as a 2 percent water-based spray, but Isotox lindane was applied at the registered rate of 1.3 percent. For this test, tree selection, plot design, and application techniques were similar to the 1976 test except that the insecticides were applied to alternate blocks of 25 trees for statistical comparison. Lindane provided only 45 percent protection, but none of the Sevimol–4® treated trees were attacked.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Some Douglas-fir mortality was detected on the Targhee and Caribou National Forests, Idaho. However, markedly fewer groups of infested trees were found there this year as compared with last year. The Payette National Forest, Idaho, showed the largest drop in number of infested groups—from 226 in 1976 to 52 in 1977. At the same time, infested groups increased markedly on the Boise National Forest, Idaho. Outbreaks were located along the South Fork of the Payette River from Lowman to Grandjean and along the South Fork of the Boise River from Anderson Ranch Reservoir to the Big Smokey area of the Sawtooth National Forest.

Large groups of beetle-killed trees were common in stands defoliated by the Douglas-fir tussock moth in 1973. These groups were along Big and Little Water Creeks and Willow Creek drainages on the Sawtooth National Forest, Idaho. Tree mortality continued on the Salmon National Forest near North Fork, Idaho, and along the lower reaches of Panther Creek. Elsewhere on the Salmon National Forest, the Douglas-fir beetle killed fewer trees this year than during the epidemic of 4 years ago.

Western pine beetle, *Dendroctonus brevicomis* LeC. This insect and the pine engraver killed more ponderosa pine on the west sides of the

Ponderosa pines killed by Ips pini *(Say), Town Creek Plantation, Boise National Forest, Idaho.*

F—700476

Boise and Payette National Forests, Idaho, this year than last. Most of the western pine beetle attacks were in overstocked stands near Sagehen Reservoir on the Emmett Ranger District, Boise National Forest, and throughout ponderosa stands along the main Weiser River north of Fruitvale, Idaho. The salvage logging near Sagehen Reservoir in 1976 effectively reduced tree mortality by this insect from several 200-tree groups to only a few small groups in 1977.

Pine engraver, *Ips pini* (Say). Pine engraver outbreaks increased significantly on the Boise and Payette National Forests, Idaho. On the Payette National Forest, infested groups rose from 23 in 1976 to 150 in 1977, while on the Boise National Forest infested groups went from 29 in 1976 to 162 in 1977. About half of the new groups were associated with logging activities. Elsewhere, drought stress and the pine engraver killed stagnated second-growth ponderosa pines. Several infestations on the Boise National Forest were evaluated. The chronic infestation in Clear Creek east of Boise, Idaho, continued at a high intensity. On the Boise Ranger District, the pine engraver killed about 1,200 ponderosa pines on the Trail Creek Timber Sale. On the Idaho City Ranger District, tree losses in the Town Creek plantation caused by precommercial thinnings in 1976 dropped dramatically.

Western spruce budworm, *Choristoneura occidentalis* Free. The western spruce budworm defoliated nearly 1 million acres of host type in west-central Idaho and western Wyoming. Defoliation was heaviest on the Boise and the Payette National Forests, Idaho. Budworm infestations expanded on the Boise National

Table 3.—*Extent and intensity of defoliation from the Western spruce budworm, Intermountain Region, 1964 to 1977 (in thousand acres)*

Year	Defoliation intensity			
	Light	Medium	Heavy	Total
1964	266.0	658.0	1,352.0	2,276.0
1965	465.6	254.5	795.2	1,515.3
1966	923.9	52.2	16.1	992.2
1967	162.2	54.9	1.6	218.7
1968	333.5	150.2	21.8	505.5
1969	388.8	125.4	30.2	544.4
1970	223.2	79.3	5.2	307.7
1971	229.3	110.3	34.3	373.9
1972	395.3	100.7	9.5	505.5
1973	99.7	76.4	48.0	224.1
1974	234.9	111.3	11.6	357.8
1975	568.8	130.9	33.7	733.4
1976	265.1	213.0	218.3	696.4
1977	195.3	213.3	288.6	[1]697.2

[1] An additional 291,000 acres of defoliation in the Idaho Primitive Area was detected, but not recorded by intensity.

Table 4.—*Location and intensity of defoliation from the western spruce budworm, Intermountain Region, 1977 (in acres)*

National Forests and adjacent private lands	Defoliation intensity			
	Light	Moderate	Heavy	Total
Boise	43,495	42,009	46,592	132,096
Bridger-Teton	30,700	21,100	800	52,600
Challis	0	28,802	0	28,802
Payette	46,484	67,587	239,998	354,069
Salmon	68,257	47,104	0	115,361
Targhee	6,400	6,200	1,200	13,800
Grand Teton N.P.	0	500	0	500
Idaho Primitive Area	0	0	0	[1]291,037
Total	195,336	213,302	288,590	988,265

[1] Defoliation in the Idaho Primitive Area was not classified by defoliation intensity.

Forest near Sagehen Reservoir and Packer John Mountain. Infested stands on and near the Payette National Forest suffered the most severe damage in the Region. Topkill occurred particularly in understory grand fir. Defoliation was less severe in mixed Douglas-fir and true firs stands. Extent and intensity of defoliation from western spruce budworm during the past 14 years are given in table 3.

An infestation on the Bridger-Teton National Forest, Wyo., decreased to about half the acreage defoliated in 1976, but a new area of defoliation was detected on about 500 acres on the Black Trail Butte in Grand Teton National Park, Wyo. A large increase in defoliation was detected on the Salmon National Forest, Idaho, for the first time since 1965. More than 115,000 acres were defoliated there in 1977 as compared with 1,300 acres in 1976. Defoliation was evident north of the main Salmon River and from the confluence of Panther Creek southward into the Cobalt area and along the Salmon portion of the Middle Fork of the Salmon River. Infestations in the Idaho Primitive Area declined to about 290,000 acres in 1977. The extent and intensity of western spruce budworm infestations in the Intermountain Region in 1977 is shown in table 4.

An insecticide pilot project—in which Orthene® at ½ lb per gallon per acre was applied—was conducted near McCall, Idaho. An unadjusted larval mortality of 91 percent was achieved. Registration of Orthene® for western spruce budworm control is pending.

Because of the continuing impact of budworm infestations on the Boise and Payette National Forests, Idaho, a suppression project for 1978 is being considered. The final decision for suppression will be made early in 1978.

Other Insects (R-4)

Insect	Host(s)	Localities	Remarks
Western tussock moth *Orgyia vetusta* (Bois.)	Deciduous trees and shrubs	Boise National Forest, Idaho	Severe defoliation in isolated areas
Spruce beetle *Dendroctonus rufipennis* (Kby.)	Engelmann spruce	Huntington Canyon, Manti-La Sal National Forest, Utah	Scattered tree mortality
Douglas-fir tussock moth *Orgyia pseudotsugata* (McD.)	Douglas-fir, true firs	All National Forests in Region except Caribou National Forest, Idaho, Bridger-Teton National Forest, Wyo, Ashley National Forest and Dixie National Forest, Utah	Undetectable defoliation, a few males in pheromone traps

Status of Diseases

Lodgepole pine clearcuts were surveyed on the Ashton and Island Park Ranger Districts, Targhee National Forest, to determine how effectively past clearcutting practices had controlled dwarf mistletoe (*Arceuthobium americanum* Nutt. ex Engelm.)

A total of 24,648 acres of clearcuts were completely examined. All overstory, infected-overstory, and infected-understory trees were counted. On the Ashton District, 18,646 acres of clearcuts still supported 12,754 overstory trees of which 8,495 were infected (0.46 infected trees/acre). There were 3,682 infected understory trees (0.2 infected trees/acre). On the Island Park District, 6,002 acres were surveyed. There were 3,035 overstory trees of which 1,202 were infected (0.2 infected trees/acre). A total of 67 infected understory trees were associated with the infected overstory trees.

Control of dwarf mistletoe during logging operations and followup timber stand improvement activities are the most effective methods of reducing the impact of this pathogen on the timber resource. To be effective, these activities must be carried out so that as many infected trees as possible are killed or removed.

The practice of planting nonsusceptible species in areas with infected overstory trees can reduce impact, slow or stop spread of the parasite, and hasten plant succession. Planting susceptible species under infected overstory trees can result in severe growth loss of the planted seedlings. Many of the lodgepole pine clearcuts surveyed had been planted with lodgepole pine, a practice that has been common on Ranger Districts throughout Region 4.

Trees that remained on 1,000 acres of selectively logged Bureau of Land Management lands were surveyed for dwarf mistletoe infections. Almost all areas were Douglas-fir type. Little or no Douglas-fir mistletoe (*A. douglasii* Engelm.) was found in mixed Douglas-fir and lodgepole pine stands, but lodgepole pine was heavily infected with lodgepole pine dwarf mistletoe.

Campgrounds and other developed sites on the Payette, Sawtooth, Salmon, and Toiyabe National Forests were surveyed for hazardous green trees. All trees that would, if they fell, be used for picnic tables, firepits, vehicle-pad areas, and other developments were examined for defects. Such trees were examined for root, butt, and trunk rots; dead limbs; cankers; dead and multiple tops; excessive lean; undercutting of roots; and other mechanical injuries. Trees with any of these defects were rated as low, medium, or high hazards. Many trees examined had more than one defect. The most common causes for high hazard ratings were root rots, butt and trunk rots, leaners, and bole cankers.

Dead and dying trees and roadside vegetation were common along highways where salt had been used for deicing. Damage was reported in Walker Canyon, Targhee National Forest, and along the east shore of Lake Tahoe.

California Region (R-5)

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Conditions in Brief

The rising trend of tree killing by pine bark beetles that began in 1976 continued in 1977. By early fall, the increase was most apparent in the low elevation ponderosa pine type throughout northern California, north of the Tehachapi Mountains. The death of young- and old-growth sugar pine increased manyfold in 1977, as did tree mortality in the east-side pine type.

This increase in tree mortality, directly related to the unprecedented drought in northern California the last 2 years, is expected to continue in 1978. Tree mortality is greatest in stands where growing conditions, even in times of adequate moisture, are less than satisfactory. Some factors contributing to increased mortality are: overstocking; shallow soils, especially on ridge tops; moderate to heavy dwarf mistletoe infections; root diseases; and disturbances such as recent road construction and winter and spring logging with inadequate slash disposal.

Because more tree mortality is expected in 1978, all forest landmanagers were again urged to maintain or increase salvage programs emphasizing prompt removal of dying trees for sanitation and optimum recovery of volume and grade.

Southern California, long known for frequent periods of drought, has experienced normal precipitation since 1973 and the amount of tree mortality is at an alltime low.

The status of defoliators was mixed. The lodgepole needleminer infestation at Yosemite National Park increased greatly in size and severity. White fir sawfly larvae were numerous locally, but no defoliation was reported. Sharp rises in the numbers of male Douglas-fir tussock moths, caught in sticky traps baited with a synthetic pheromone, may portend defoliation of white fir by this insect in 1978. Two usually innocuous defoliators, the silverspotted tiger moth and the tent caterpillar, caused severe defoliation over several thousand acres of host trees. Infestation from each is expected to collapse in 1978.

Insect/disease complexes (root disease, dwarf mistletoes, bark beetles, and flatheaded borers) caused 80 percent of the tree mortality on the San Bernardino and Cleveland National Forests.

Douglas-fir, red fir, and sugar pine 1–0 seedlings were killed by *Fusarium* sp. at Federal and State nurseries.

Ohia forest decline is the major concern in Hawaii.

Status of Insects—California

Douglas-fir tussock moth, *Orgyia pseudotsugata* (McD.). Larval populations, which have been light since the 1970–73 outbreak, are increasing. The number of male moths caught in population assessment pheromone traps was considerably greater than in 1976. Pupal/egg mass samples will be taken this fall and egg mass/larval samples will be taken in the spring of 1978 to determine the significance of this increase.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Tree killing by the Douglas-fir beetle was light in 1977, although late summer observations indicate some increased activity in the Sierra Nevada. At one location in El Dorado County, tree killing may have been provoked by disturbance associated with construction at the nearby Auburn Dam Site. Currently infested groups of trees near Grizzly Peak, Plumas County, are scheduled for salvage by the spring of 1978.

Western pine beetle, *Dendroctonus brevicomis* LeC. From Tulare County north, western pine beetle activity is reported to be up considerably over that of 1976. Tree mortality appears greatest in the lower elevation pine type of the Sierra Nevada in the approximately 3,000- to 4,000-foot elevation. Pine engraver beetles, *Ips* spp., and drought often contribute to the death of the trees, as do more localized site properties and stand conditions such as overstocking, shallow soils, or recent logging disturbance.

Some areas with unusually high numbers of dead trees are in the vicinity of Arnold and Rattlesnake Hill, Calaveras County; Todd Valley and Iowa Hill, Placer County; Slab Creek Reservoir and Beanville, El Dorado County; Nevada City, Nevada County; Lake Oroville, Butte County; Dogwood Creek and Chambers Peak, Plumas County; the Burney-Hat Creek area and east of Buckhorn Summit on Highway 299, Shasta County.

Fir engraver, *Scolytus ventralis* LeC. As in 1976, scattered top and tree killing occurred throughout

much of the host range. At five locations, namely Butte Mountain, Siskiyou County; Adin Summit, Modoc County; Emigrant Gap, Placer County; and Ferris Cabin and Thompson Peak, Plumas County, the damage was severe enough to concern the land managers. At these locations, root diseases, specifically *Fomitopsis annosa*, or drought were either confirmed or suspected to have predisposed the trees to attack by the fir engraver.

Flatheaded fir borer, *Melanophila drummondi* (Kby.). The amount of Douglas-fir mortality in northwest California has decreased since 1975 and 1976. A combination of the flatheaded fir borer, dwarf mistletoe, and overstocking are thought to be the cause of the earlier mortality.

California flatheaded borer, *Melanophila californica* (Van Dyke). California flatheaded borer activity is at a low ebb in southern California. In northern California, however, evidence of flatheaded borer damage is readily apparent in Jeffrey, sugar, and ponderosa pine trees stressed by drought, dwarf mistletoe, or other factors.

Pine engraver beetles, *Ips* spp. Damage by the pine engravers increased markedly over that of 1976. Several instances were reported where ips beetles alone caused considerable top and whole tree killing. Additionally, most reports which listed mountain pine beetle, western pine beetle, or Jeffrey pine beetle as a causal agent also list *Ips* spp. as contributing to the death of the trees.

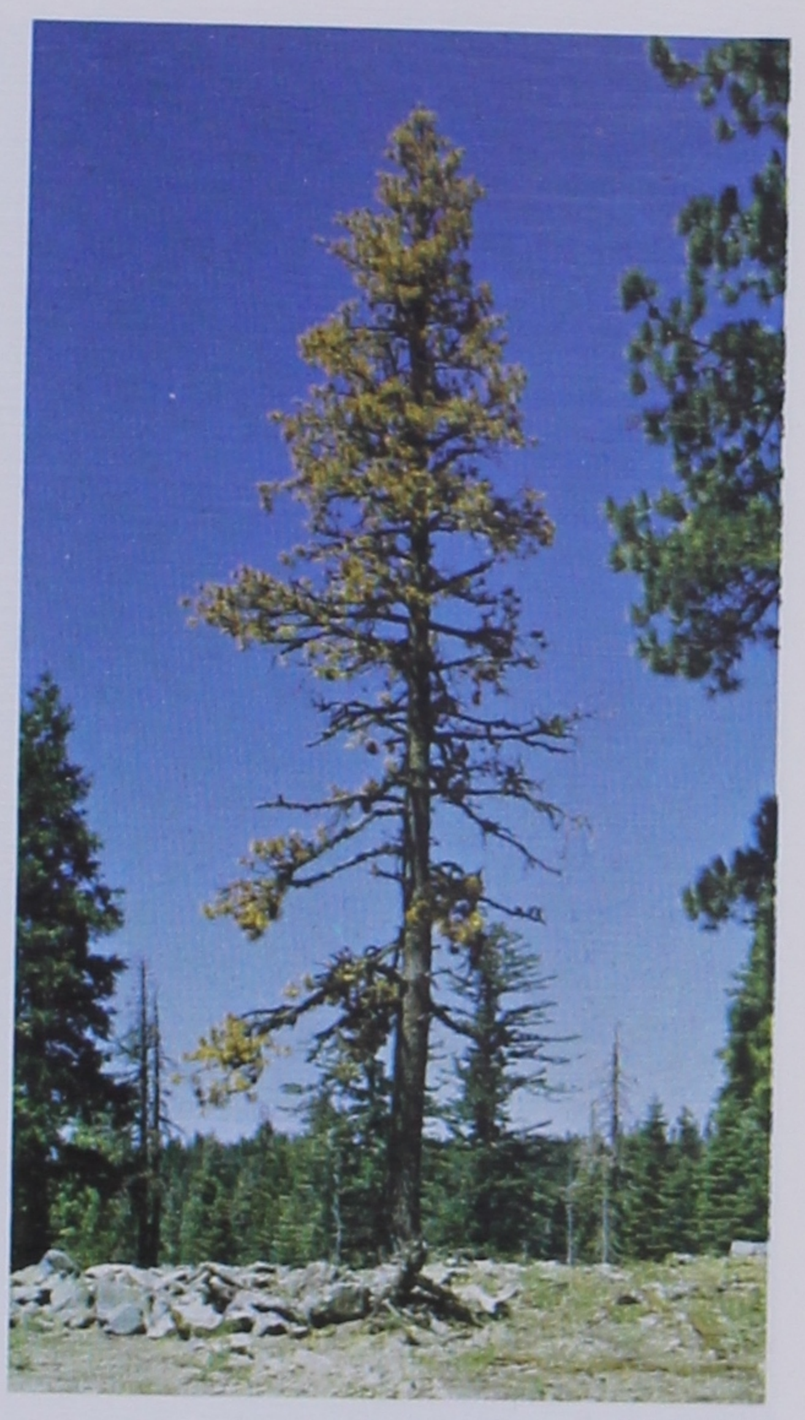
Ips spp. outbreaks occurred at San Pablo Reservoir, Contra Costa County; Hathaway Pines, Calaveras County; Glenhaven and Salminas Road, Lake County; vicinity of Montgomery Creek and East of Buckhorn Summit on Highway 299, Shasta County. Factors contributing to the elevated ips activity were the drought, logging slash, dwarf mistletoe, and poor site.

Red turpentine beetle, *Dendroctonus valens* LeC. At San Pablo Reservoir, Contra Costa County, red turpentine beetles and engraver beetles are principally responsible for severe mortality in Monterey pine plantations established there in the early 1930's. Because Monterey pine is not native to the area and such stands become increasingly susceptible to pest problems after about 40 or 50 years of age, no suppression action is recommended. Instead, regeneration of the affected areas with native shrubs, oaks, and grasses may be the best course of action.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. The mountain pine beetle killed considerably more trees in 1977 than last year. The most significant and widespread increase was in sugar pine stands, but some localized damage also occurred in ponderosa pine. In normal years, only the scattered large sugar pines injured by lightening strikes are attacked by beetles. This year, the incidence of dying sugar pine has risen sharply; both young and old trees were attacked and group tree killing is common, indicating that the drought is a major predisposing factor.

Notable increases in sugar pine mortality occurred at Colby Mountain and Onion Butte, Butte County, vicinity of Mosquito Creek and Hat Creek, Shasta County; Corral Bottom, Trinity County; Fiddletown Road, Amador County; and vicinity of Plummer Ridge, El Dorado County.

Jeffrey pine beetle, *Dendroctonus jeffreyi* Hopk. Jeffrey pine beetles caused increased tree killing at Silverfork and Alder Creek, El Dorado County; Carmen Valley, and near the junction of Highways 89 and 49, Sierra County; along Lake Davis Road and in the vicinity of Antelope Lake, Plumas County; and at Honey Lake, Lassen County. In the Antelope Lake infestation, 700,000 board feet of infested trees were salvaged. Drought conditions, ips beetles, and needle cast disease contributed to the death of the trees.



F—700477

Jeffrey pine killed by dwarf mistletoe and the Jeffrey pine beetle, San Bernardino National Forest, Calif.

Tent caterpillars, *Malacosoma* spp. This infestation is centered around the heavily used Chilolo Campground, giving rise to Tribal concerns as to the effect continued defoliation may have on recreational use of the area.

Tent caterpillars defoliated some 2,000 acres of mountain-mahogany and blue oak for the second consecutive year on the Tule River Indian Reservation, Tulare County.

Map 3—*Location of drought-caused mortality, 1977.*

Silverspotted tiger moth, *Halisidota argentata* (Pack.). At Eden Valley, Elk Creek in Mendocino County, epidemic numbers of the silverspotted tiger moth severely defoliated all plant species including Sargent Cypress, digger pine, ponderosa pine, and madrone on some 2,500 acres. Healthy larvae were feeding only in a narrow fringe on the border of the infestation. In the heavily defoliated central position, dead and dying larvae were found in abundance, suggesting death from starvation and exposure.

White fir sawflies, *Neodiprion* spp. No damaging infestations of white fir sawflies were reported in 1977, although larvae were present and often abundant throughout much of the host type.

Lodgepole needleminer, *Coleotechnites milleri* (Busck). Needleminer populations increased at nearly all monitoring locations in Yosemite National Park. Increases in excess of 500 percent were observed on 10 of 26 plots.

At some needleminer locations, populations were static or had declined because maximum sustainable population densities had been reached in the previous generation.

The total area defoliated increased greatly. Newly defoliated areas of particular interest were found along Highway 120, east of Tenaya Lake, east of Tuolumne Meadows, along the John Muir Trail, and in Lyell Canyon.

Preliminary sampling of new populations indicates an upward population trend, and defoliation of Tuolumne Meadows Campgrounds is likely in 1979. No control action is planned by the National Park Service.

Insects damaging plantations and young trees. Pine sawflies, *Neodiprion* spp., and the pine resin midge, *Cecidomyia piniinopis* O.S., were the insects most frequently reported as causing injury to young trees. At Humboldt Nursery, an increasing and damaging infestation of cooley spruce gall aphid, *Adelges cooleyi* (Gill.), on Douglas-fir seedlings was successfully treated with carbaryl formulation. A coneworm, *Dioryctria* sp., attacked 45 percent of some 500 grafted, but unprotected ponderosa pine, at the Forest Service Tree Improvement Center at Chico in Butte County.

Status of Insects—Hawaii

Geometrid moth, *Scotorythra paludicola* (Butler). An outbreak of this moth on the island of Maui heavily defoliated some 4,500 acres of economically important *Acacia koa*.

Eucalyptus longhorn beetle, *Phorocantha semipunctata* (Fab.). On the island of Kauai, the combined effects of drought and attacks by this longhorn beetle are causing a general decline of *Eucalyptus robusta*.

Eurasian pine aphid, *Pineus pini* (Koch.). The Eurasian pine aphid was discovered for the first time on Molokoi in a 5-acre *Pinus pinaster* plantation. On Maui, introductions of a chamaemyiid fly, parasitic on this aphid, are considered successful.

Status of Diseases—California

Drought. The drought continued for the second year. Except for the month of May when rainfall was above average, abnormally low rainfall has been one of the dominant factors influencing the insect and disease situation in the California forests north of the Tehachapi Mountains.

Most of the tree mortality observed this summer that could be directly or indirectly associated with the drought was the result of reduced rainfall in 1976. This fall, there has been a noticeable increase in the amount of mortality that is attributable to the continuing drought. Tree mortality will probably increase through the winter of 1977 and into spring of 1978.

A survey of the tree mortality on drought-stricken National Forests of California was made this year. A total of 160 280-acre plots was chosen at random, photographed, and interpreted for trees which died between May 1976 and May 1977. Many of the trees died during the 1976 drought stress period. A sample of 115 mortality groups identified on

Drought-associated tree mortality was evident late in the year in fringe areas of the low elevation ponderosa pine type.

F—700478

the photos was ground checked in the fall of 1977.

By May 1977, an estimated 6.45 million trees on 6.33 million acres in the 12 northern National Forests had died. The estimated volume loss was 3.09 billion board feet. About 85 percent of the volume lost was on the better sites, A, 1 and 2. About 78 percent of this loss occurred in the mixed conifer and red fir types.

Although the drought was a major factor contributing to these losses, forest insects and diseases were also involved. These pests appeared to play one of two roles. The long term endemic diseases, such as root diseases and dwarf and true mistletoes, predisposed the trees to drought stress, which allowed bark beetles and flatheads to kill the drought-stressed trees.

The estimated 3 million board feet is only part of the loss to be expected from the 1976–77 drought.

Foliage diseases. The drought has reduced the amount of damage caused by foliage diseases. In 1976, there was enough rainfall in the spring to allow *Lophodermella arcuata* (Dark.) to continue as a problem on sugar pine in Calaveras, Placer, and Tuolumne Counties in 1977. In southern California, the 1977 spring tropical storms created conditions favorable for an epidemic of sycamore anthracnose on sycamore in Los Angeles County.

Root diseases. *Fomitopsis annosa* (Fr.). Karst continues to be a problem on recreation sites in southern California. On the San Bernardino and Cleveland National Forests, *F. annosa* and/or dwarf mistletoe in combination with insects were responsible for most of the pine mortality on recreation sites on these two southern California forests.

F. annosa also killed red and white fir in the Lake Tahoe Basin at Tahoe City and Homewood.

Armillariella mellea (Vahl. ex Fr.). Karst is part of a pest complex, which includes dwarf mistletoe or true

F—700479

[1] *Douglas-fir 1–0 seedlings killed by* Fusarium oxysporum *at Humboldt Nursery, Calif.*

F—700480

[2] *Two-lined ohia borer,* Plagithmysus bilineatus *on ohia in Hawaii.*

mistletoe and insects, that is killing red fir and/or white fir. On the Lassen, Plumas, Tahoe, and Stanislaus National Forests, the disease was associated with dwarf mistletoe and insects, on both red and white fir. It is not known whether *A. mellea* is acting as a primary pathogen on true fir or a weak pathogen taking advantage of trees under stress due to numerous dwarf mistletoe infections and drought.

On the Sequoia National Forest, *A. mellea* was acting as a primary pathogen killing red fir and sugar pine in an area where the red fir was heavily infected with true mistletoe.

Nursery diseases. *Fusarium* sp. was a major problem at Federal (F) and State (S) nurseries. This fungus killed significant numbers of 1–0 Douglas-fir at Humboldt (F) Nursery and 1–0 sugar pine and red fir at Magalia (S) and Placerville (F) Nurseries.

At the Chico Tree Improvement Center (F), more than 5 percent of their containerized rust-resistant 1–0 sugar pine were killed by *Fusarium* sp.

At the Humboldt (F) Nursery, *Botrytis cinerea* (Pers. ex Fr.) was a problem in 1–0 coast redwood. Strains of *B. cinerea* resistant to control by benomyl have been recognized for a number of years in nurseries producing container-grown seedlings on the north coast. This year, a resistant strain may be infecting coast redwood bareroot stock. This strain has not been tested for resistance, but benomyl is not controlling the spread of the fungus.

Nursery disease control. *Macrophomina phaseoli* (Maubl.) Ashby. The three registered mixtures of methyl bromide-chloropicrin (67–33, 75–25, 982) were evaluated to determine which mixture was most effective in controlling *M. phaseoli* at a rate of 400 lbs/acre. All the mixtures were equally effective.

Botrytis cinerea (Pers. ex Fr.). A number of chemical compounds were tested in a containerized greenhouse to determine the most effective chemicals for controlling *B. cinerea*. Dicloran (Botran) and chlorothanil (Bravo) were significantly better than the other chemicals tested.

Air pollution (Ozone). Ozone injury symptoms on ponderosa and Jeffrey pines are present throughout the forests adjacent to the San Joaquin Valley, from Tuolumne County south to Kern County. Further to the east, at greater distance from urban pollution sources, injury symptoms are infrequent.

Status of Diseases—Hawaii

Ohia forest decline. The decline of ohia trees on the island of Hawaii continues to be the major forest disease problem in the State. Over 250,000 acres of ohia forest are affected by the decline, some of them severely. The two pests—an insect, *Plagithmysus bilineatus* Sharp, and a pathogen, *Phytophthora cinnamoni* Rands—are found associated with the decline, but other, yet unknown factors, are also believed to be responsible.

Pacific Northwest Region (R-6)[4]

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Conditions in Brief

Tree mortality from bark beetles increased sharply in Oregon and Washington in 1977, primarily because of the severe droughts during 1976 and 1977.

The mountain pine beetle killed extensive numbers of lodgepole and ponderosa pines in eastern Oregon and Washington.

Western pine beetles killed an increasing number of mature ponderosa pines in central and southwest Oregon.

Tree losses from the Douglas-fir beetle remained high in Oregon and Washington.

The western spruce budworm caused light to heavy defoliation on 1.2 million acres of mixed conifer stands. Nearly 357,000 acres of budworm-infested stands were sprayed with Sevin® 4 oil this year. Budworm egg mass surveys in the treated and untreated areas will predict the intensity of defoliation likely to occur in 1978.

Needle disorders, root rots, and drought injury were the most visible disease problems in 1977. A needle blight on young lodgepole pine intensitified on several thousand acres in eastern Oregon and Washington. Swiss needle cast damaged Christmas tree plantations in southwestern Washington, and elytroderma needle blight was common on eastside ponderosa pine. Laminated root rot, armillaria root rot, annosus root rot, and black-stain root disease were reported with increased frequency as foresters became more aware of them. Drought damage was widespread and sometimes spectacular on many tree species.

Status of Insects

Western spruce budworm, *Choristoneura occidentalis* Free. This insect defoliated about 1.2 million acres of Douglas-fir and true fir stands in Washington and Oregon for the second consecutive year. Defoliation was most severe on the Okanogan and Wenatchee National Forests, North Cascades National Park, and on the Warm Springs Indian Reservation, Oreg. The extent of 1977 defoliation by ownership is summarized in table 5.

Defoliated acreage decreased in Washington on the Okanogan National Forest and Colville and Yakima Indian Reservations, but increased on the North Cascades National Park and on State and private lands adjacent to the Okanogan National Forest. Ground surveys indicated increases in budworm populations east of the Okanogan River near Oroville, Wash., although defoliation was not visible from the air. The defoliated area increased by about 8,000 acres on the Warm Springs Indian Reservation, Oreg.

Approximately 357,000 acres of infested Douglas-fir and true fir in Washington were aerially sprayed with Sevin® 4 Oil—at 1 pound active ingredient per acre in one-half gallon of total formulation. The treatment effectively reduced the budworm populations to less than the project goal of three larvae per 100 buds.

Budworm egg mass surveys were made in treated and untreated areas in the fall of 1977 to predict the intensity of defoliation that could occur in 1978. Budworm populations have remained at a low density in the sprayed areas. The high density

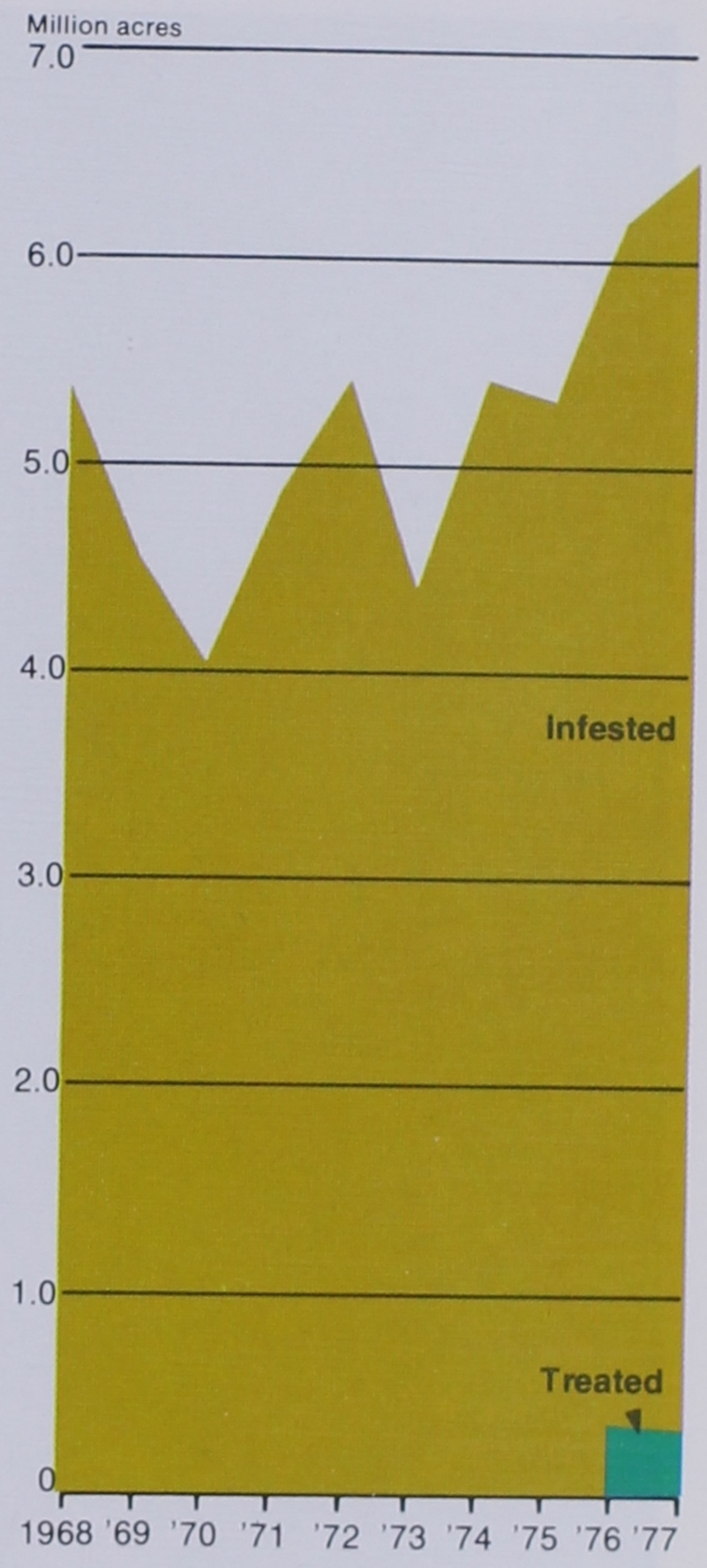


Chart 1—*Trend of western spruce budworm infestations and control in the Western United States, 1968–77.*

[4] Contributions for this report came from the Oregon State Departments of Agriculture and Forestry, the Washington State Department of Natural Resources, and the Forest Service, Pacific Northwest Forest and Range Experiment Station.

F—700481

Western spruce budworm infestation, Okanogan National Forest, Wash.

budworm populations in some of the untreated areas are being evaluated to determine if control will be needed in 1978.

Modoc budworm, *Choristoneura viridis* Free. This insect lightly defoliated more than 6,910 acres of Douglas-fir and true fir on the Fremont National Forest and adjacent State and private lands in south-central Oregon. Weyerhaeuser Corporation treated about 1,600 acres of Modoc budworm-infested white fir with Orthene® Forest Spray at ½ pound and 1 pound active ingredient per acre. The effectiveness of the insecticides is unknown.

Larch casebearer, *Coleophora laricella* (Hbn.). New populations were found in western larch stands on the Mt. Hood and Deschutes National Forests and Warm Springs Indian Reservation, Oreg. These localities extend this insect's range to cover all the western larch forest type in the Oregon Cascades. The insect was also detected for the first time south of John Day, Oreg., on the Malheur National Forest. The insect has not yet been found on the Ochoco National Forest, Oreg.

Light to heavy defoliation occurred on 408,300 acres in Oregon and Washington with the most intense feeding on the Umatilla and Wallowa-Whitman National Forests, Oreg., and on the Umatilla and Colville National Forests, Colville Indian Reservation, and on adjacent State and private lands of Washington.

Three introduced species of larch casebearer parasites were collected in Region 6 during 1977. Dr. Roger Ryan, Pacific Northwest Forest and Range Experiment Station, reported the establishment of *Agathis pumila* (Ratz.) in the Blue Mountains, Oreg.; *Chrysocharis laricinellae* (Ratz.) is also established in the Blue Mountains since it was recovered near plots where it had been released in 1974.

Table 5.—*Extent of western spruce budworm defoliation by ownership in Oregon and Washington (R–6), 1976–77*
(in acres)

State, Area, and ownership	Visible defoliation	
	1976	1977
Oregon		
Malheur area National Forest lands	380	0
Warm Springs Indian Reservation	10,800	18,890
Totals	11,180	18,890
Washington		
Okanogan Area		
National Forest lands[1]	330,760	234,050
National Forest dedicated lands[2]	14,790	10,340
Bureau of Land Management	390	170
State and private lands	8,040	24,560
Totals	353,980	269,120
Wenatchee Area		
National Forest lands[1]	436,520	424,620
National Forest dedicated lands[2]	36,450	94,130
Bureau of Land Management	80	0
State and private lands	183,340	274,760
Totals	656,390	793,510
North Cascades National Park	73,060	109,660
Colville Indian Reservation	2,100	910
Yakima Indian Reservation	3,310	2,620
Totals	1,088,840	1,175,820
Regional		
National Forests	818,900	763,140
National Parks	73,060	109,660
Bureau of Land Management	470	170
Indian Reservation	16,210	22,420
State and private (Washington)	191,380	299,320
Totals	1,100,020	1,194,710

[1] Excluding wilderness areas.
[2] Wilderness areas.

F—700482

Mountain pine beetle infestation in lodgepole pine and ponderosa pine, Baker Co., Oreg.

Both of these parasites have been established in Washington for several years. *Elachertus argissa* (Walk.) was collected for the first time in northeast Oregon after having been released there in 1974.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. The mountain pine beetle continues as the most destructive tree killer in the Pacific Northwest. Since 1968, this insect has killed an estimated 976.4 million board feet of pine on 1.7 million acres in northeast Oregon.

The most important outbreak in 1977 was on the Malheur, Umatilla, and Wallowa-Whitman National Forests and on adjacent State and private lands in Oregon. Lodgepole pine, mature ponderosa pine, second-growth ponderosa pine, and whitebark pine were attacked and killed. Lodgepole pine mortality was estimated in excess of 166.1 million board feet on 990,300 acres. The mountain pine beetle is spreading into the remaining stands of mature lodgepole pine, but losses in the older outbreak areas are declining because most of the suitable host material have been killed. Losses in ponderosa pine stands increased greatly within the outbreak area in 1977. About 230.6 million board feet of pine were killed on 634,600 acres. Most of the losses were in second-growth ponderosa pine stands between Baker and La Grande, Oreg. Mature ponderosa pine mortality was most evident on exposed, dryer sites. Whitebark pine stands in the Elkhorn Mountains west of Baker, Oreg., had about 1.9 million board feet killed by this beetle on 17,500 acres in the upper forest zones.

Elsewhere in the Region, the mountain pine beetle caused considerable losses to lodgepole pine stands on the Deschutes, Fremont, and Winema National Forests and adjacent State and private lands in Oregon. Significant losses also occurred on the Colville National Forest, Wash.

A great many ponderosa pines were killed on the Deschutes, Ochoco, and Winema National Forests and Warm Springs Indian Reservation, Oreg., and on the Okanogan, Wenatchee, and Colville National Forests and State and private lands north of Spokane, Wash. Tree losses are expected to increase during 1978 where drought conditions continue.

Western white pines were killed in increasing numbers on the Mt. Hood, Umpqua, and Willamette National Forests, Oreg., and the Wenatchee, Colville, and Olympic National Forests, Olympic National Park, and Yakima Indian Reservation, Wash.

Scattered sugar pines were killed on the Fremont, Rogue River, Siskiyou, Umpqua, Winema National Forests, Oreg., and surrounding lands. This mortality amounted to 247,800 board feet on 4,700 acres.

Douglas-fir beetle in down timber. F—700483

Western pine beetle, *Dendroctonus brevicomis* LeC. Numbers of ponderosa pine killed by this beetle remained high throughout eastern Oregon and Washington in 1977. About 8 million board feet of timber were killed on 114,800 acres regionwide. The most important losses were on the Deschutes, Fremont, and Malheur National Forests, Warm Springs Indian Reservation, Oreg., and on adjacent State and private lands. Losses also were greatest on the Colville and Yakima Indian Reservations, Wash.

Western pine beetle-caused losses are expected to increase in 1978 where the recent drought was most severe. A large increase in the number of western pine beetle attacks was observed during late summer on many of the dryer sites.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Douglas-fir beetle populations decreased in size, but the insect still killed about 25.6 million board feet on 103,100 acres in Region 6. Losses were greatest on the Umatilla and Wallowa-Whitman National Forests, and adjacent State and private lands in Oregon and Washington where an estimated 13.5 million board feet of Douglas-fir was killed. The most severe losses occurred in stands heavily defoliated by the Douglas-fir tussock moth between 1972 and 1974. Only scattered tree mortality was detected on the Rogue River, Siuslaw, Umpqua, and Willamette National Forests, Oreg.

Douglas-fir losses reported on the Gifford Pinchot National Forest, Wash., amounted to 1.7 million board feet. Losses were also high on the Olympic and Colville National Forests, and the Colville Indian Reservation, Wash.

Pine engravers, *Ips* spp. Tree mortality from these beetles increased greatly in 1977 with about 30,700 acres of damage being reported in Oregon and Washington. Most

of the damage was on the Deschutes, Fremont, Wallowa-Whitman, and Umatilla National Forests, Oreg., and on the Okanogan and Wenatchee National Forests, Wash. During 1977, pine engravers attacked and killed large, old-growth ponderosa pines. These trees are not usually attacked but the 1976–77 drought in central and eastern Oregon and Washington probably weakened these trees making them vulnerable to attack. Pine engraver populations are expected to remain high in 1978.

Fir engraver, *Scolytus ventralis* LeC. Populations of this beetle were low in 1977. Losses in true fir stands were estimated at 1.5 million board feet on 21,000 acres mostly on the Rogue River, Winema, and Umatilla National Forests, Oreg., and on the Gifford Pinchot, Mt. Baker-Snoqualmie, and Umatilla National Forests, Wash.

Tree losses to bark beetles in Oregon and Washington are summarized in table 6.

Table 6.—*Bark beetle infestations in Oregon and Washington (R–6), 1977*[1]

State, insect, and host(s)	Infestation			Merchantable infested volume	
	Area (thousand acres)	Number of centers[2]	Total (thousand trees)	Average vol. per tree (bf)	Total (thousand bf)
Oregon					
Douglas-fir beetle (eastside Douglas-fir)	59.9	643	24.8	546	13,540.8
Douglas-fir beetle (westside Douglas-fir)	8.7	152	1.5	1,665	2,497.5
Douglas-fir engraver (Douglas-fir)	.05	1	.02	60	1.2
Fir engraver (True firs)	10.1	199	2.0	322	644.0
Flathead borer (Douglas-fir and Ponderosa pine)	.5	9	.07	60	4.2
Mountain pine beetle (Ponderosa pine)	634.6	1,061	1,063.1	217	230,692.7
Mountain pine beetle (Sugar pine)	4.7	48	.3	826	247.8
Mountain pine beetle (W. white pine)	2.4	52	.5	207	103.5
Mountain pine beetle (Lodgepole pine)	990.3	1,162	2,407.9	69	166,145.1
Mountain pine beetle (Whitebark pine)	17.5	28	31.1	60	1,866.0
Western pine beetle (Ponderosa pine)	95.6	763	9.4	750	7,050.0
Totals	1,824.3	4,118	3,540.7		422,792.8
Washington					
Douglas-fir beetle (eastside Douglas-fir)	30.0	499	13.8	569	7,852.2
Douglas-fir beetle (westside Douglas-fir)	4.5	112	2.0	851	1,702.0
Douglas-fir engraver (Douglas-fir)	.8	19	.1	60	6.0
Spruce beetle (Engelmann spruce)	2.3	10	1.4	247	345.8
Fir engraver (True firs)	10.9	196	2.8	317	887.6
Mountain pine beetle (Ponderosa pine)	20.8	321	9.5	53	503.5
Mountain pine beetle (W. white pine)	36.0	471	15.6	455	7,098.0
Mountain pine beetle (Lodgepole pine)	5.8	40	7.1	66	468.6
Western pine beetle (Ponderosa pine)	19.2	205	1.6	563	900.8
Totals	130.3	1,873	53.9		19,764.5
Regional totals	1,954.6	5,991	3,594.6		442,557.3

[1] Excluding pine engravers.
[2] Five or more faded trees per center.

Other Insects (R-6)

Insect	Host(s)	Localities	Remarks
Douglas-fir tussock moth *Orgyia pseudotsugata* (McD.)	Douglas-fir and true firs	Deschutes, Mt. Hood, Winema, Fremont, and Malheur National Forests, Oreg., and Colville Indian Reservation, Wash.	Very low larval densities
Hemlock sawfly *Neodiprion tsugae* Midd.	Western hemlock	Mt. Baker-Snoqualmie National Forest, Wash.	Severely defoliated 2,200 acres
		Mt. Hood National Forest, Oreg.	Severely defoliated 1,500 acres
Balsam fir sawfly *Neodiprion abietis* (Harr.)	White fir	Fremont National Forest, Oreg.	Lightly defoliated 2,600 acres
A conifer sawfly *Neodiprion* sp.	Douglas-fir	Siskiyou National Forest, Oreg.	Lightly defoliated 4,200 acres
Western blackheaded budworm *Acleris gloverana* (Wals.)	Grand fir and Douglas-fir	Southeast of Dixie Butte, Oreg.	Localized light defoliation
A larch budmoth *Zeiraphera griseana* (Hbn.)	Western larch	Wenatchee National Forest, Wash.	Lightly defoliated 28,400 acres
		Colville National Forest, Wash.	Lightly defoliated 5,600 acres
Western oak looper *Lambdina fiscellaria sommiaria* (Hulst)	Oregon white oak	Washington, Yamhill, Polk County, Oreg.; and Lewis County, Wash.	Severely defoliated 6,700 acres
		Borst Park, Centralia, Wash.	15 acres infestation treated with 2 qts. Guthion® (50% EC) in 50 gals water
Tent caterpillars *Malacosoma* spp.	Alders and willows	Columbia River valley from Portland to St. Helens, Oreg.	Severe defoliation
Fall webworm *Hyphantria cunea* (Drury)	Deciduous trees	Marion County, Oreg.	Damage to shade trees
Spruce beetle *Dendroctonus rufipennis* (Kby.)	Engelmann spruce	Wenatchee National Forest, Wash.	Scattered tree-killing on 2,200 acres

Other Insects (R-6) *(Continued)*

Insect	Host(s)	Localities	Remarks
Douglas-fir engraver *Scolytus unispinosus* LeC.	Douglas-fir	Colville National Forest, Wash.	Scattered top-killing on 720 acres
		Mt. Hood National Forest, Oreg.	Tree mortality severe on 50 acres
Flatheaded wood borers *Melanophila* spp.	Douglas-fir and ponderosa pine	Medford and Grant Pass, Oreg.	Decreased tree mortality in foothills around towns
Spruce aphid *Elatobium abietimum* (Wlk.)	Sitka spruce	Pacific coasts of Washington and Oregon	Light to severe defoliation on 37,000 acres
		Westport, Wash.	Tree-killing on residential properties
European pine shoot moth *Rhyacionia buoliana* (Schif.)	Ornamental pines	Woodburn, McNary Dam, and Hermiston, Oreg.	5,200 ornamental pines treated with 2 lbs Lindane® 50 WP in 100 gal water
Black pineleaf scale *Nuculaspis californica* (Cole.)	Sugar pine and ponderosa pine	South-central Oregon	Damage covers 11,000 acres
		Upper Klamath Lake, Oreg.	Tree-killing evident on 720 acres
Balsam woolly aphid *Adelges piceae* (Ratz.)	True firs	Western Oregon and Washington	Damage evident on 22,500 acres
	True firs	State and private lands in Blue Mountains near Tollgate, Oreg.	New infestation center detected
Douglas-fir twig weevil *Cylindrocopturus furnissi* Buch.	Douglas-fir	State Forestry Nursery, Lane County, Oreg.	75 percent of the 2–1 Douglas-fir
Strawberry root weevil *Brachyrhinus ovatus* (L.)	Noble fir	Rochester, Wash.	Localized killing of 3- to 5-year old trees throughout plantations

Status of Diseases

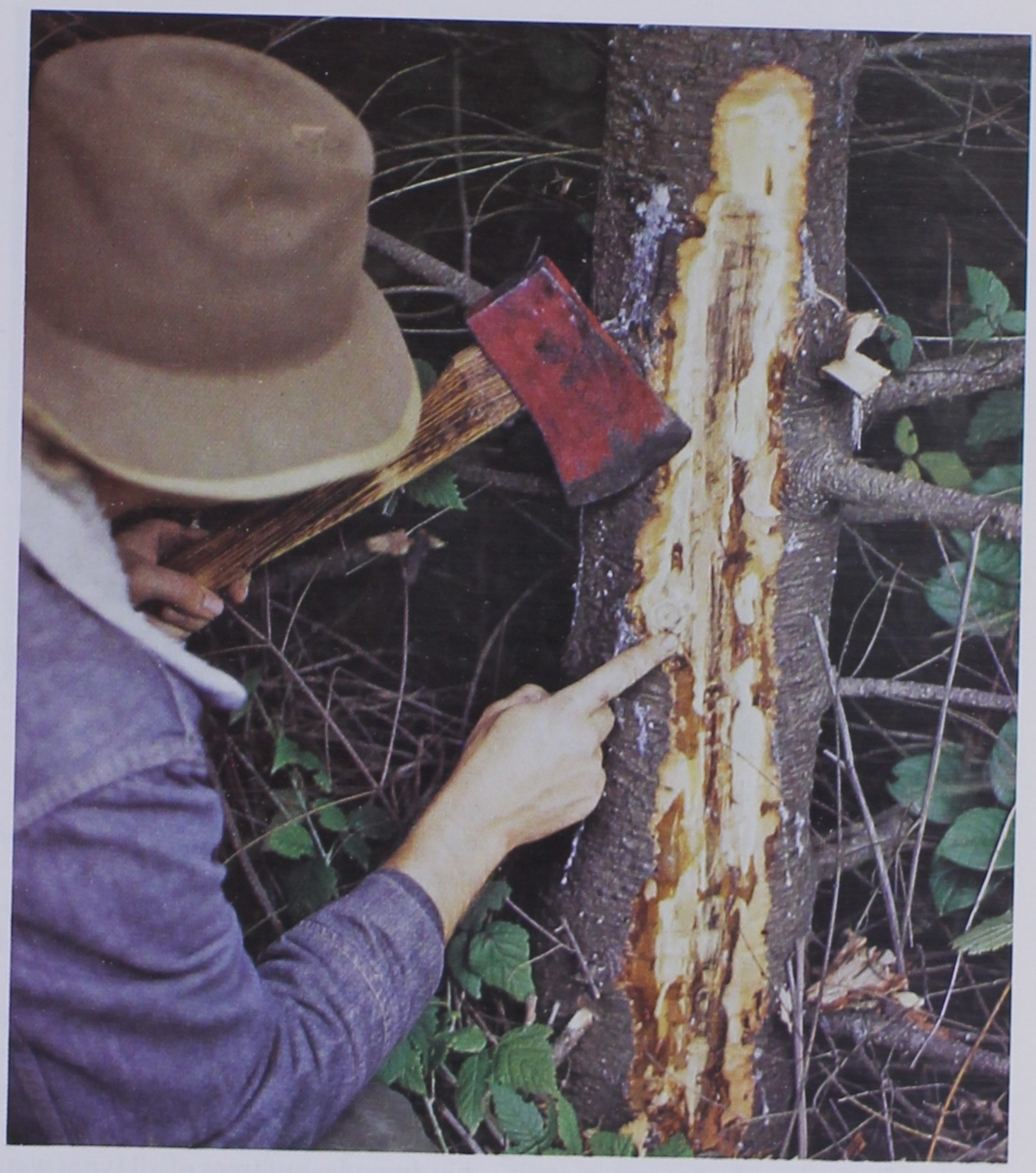
Needle cast, caused by *Lophodermella concolor* (Dearn.) Darker, affected pole and sapling size lodgepole pine in eastern Oregon in 1975. In 1976 the disease was widespread on several thousand acres between Prairie City and Troy, Oreg. By 1977, the disease had increased in intensity and was found over a larger area. The disease was especially noticeable around Colville, Wash. Infection occurred on many formerly undiseased trees or increased on lightly diseased trees. Infection is favored by moist conditions in spring and early summer. Though this was a dry year, rainfall in the spring may have created favorable conditions for infection, and the disease may be prevalent in 1978. Reduction of growth is the principal damage; little tree killing is expected.

Douglas-fir needle cast, caused by *Rhabdocline pseudotsugae* Syd., was severe in scattered stands. Disease ratings increased slightly over those of 1976 in permanent plots near Cottage Grove, Oreg. Damage consists mostly of growth loss, and the disease is most serious on off-site trees. Infection is favored by moist spring weather.

Swiss needle cast, caused by *Phaeocryptopus gaumanni* (Rhode) Petrak, on Douglas-fir is similar to rhabdocline needle cast. The disease damaged several Christmas tree plantations near Winlock, Wash.

Dwarf mistletoes, *Arceuthobium* spp., are still one of the most damaging groups of pathogens in the Pacific Northwest. Almost all conifer species are infected. Management practices to reduce losses are well understood and are being used by most foresters. Dwarf mistletoe impact is lessening as control practices are more generally applied.

Noble, Pacific silver, and white fir on several thousand acres on the Deschutes, Willamette, and Umpqua National Forests, Oreg., were damaged by a combination of dwarf mistletoes and canker fungi. The canker fungi invade through dwarf mistletoe infections and kill branches and trees.



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Black-stain root disease on Douglas-fir, Yamhill Co., Oreg.

The importance of avoiding wounding trees to prevent stem decay from becoming established is still not appreciated by many foresters. A myth that the decay problem will disappear with the old-growth has been perpetuated in the Pacific Northwest. Actually, decays are a major cause of losses and probably will continue to be so in the future. A survey of understory white fir 4-inch dbh left after overstory removal on the Fremont National Forest showed that 46 percent of the residual crop trees had scars and many were infected by *Echinodontium tinctorium* (E.&E.) E.&E. *Hericium* sp., or *Pholiota* sp.

Dutch elm disease, caused by *Ceratocystis ulmi* (Buism.) C. Mor., was discovered for the first time in Portland, Oreg. One infected tree was found and promptly destroyed. The disease had previously been found only in Union, Nyssa, and

F—700485

Laminated root rot on grand fir, Kittitas Co., Wash.

Ontario, Oreg. The disease was also found in Walla Walla, Wash. This is the first report of Dutch elm disease in Washington.

Annosus root rot, caused by *Fomitopsis annosa* (Fr.) Karst. (= *Fomes annosus* (Fr.) Cke.), affects many tree species. It causes a serious root and butt rot of western hemlock. Surveys of second-growth western hemlock stands in Oregon and Washington showed that virtually all were infected. An increase in annosus root rot mortality was found in a ponderosa/Jeffrey pine plantation near Silver Lake, Oreg. Trees that died were probably infected in previous years; the drought weakened them sufficiently for the root rot to spread rapidly.

Black-stain root disease, caused by *Verticicladiella wagenerii* Kendrick, was found in many new locations in western Oregon and Washington. Two areas with extensive occurrence of the disease were Green Basin, Marion County, and Ball Bearing Hill, Yamhill County, Oreg. The disease, a vascular wilt, is most commonly found in 10- to 30-year-old Douglas-fir plantations. Infected trees die quickly.

Extensive tree damage was associated with the severe drought of 1976–77 in the Pacific Northwest. The effects of the drought will probably be felt for years to come. Effects were most noticeable in young conifers on severe sites and on hardwoods, but trees of all types were damaged. Drought-affected hardwoods suffered foliage drying, early leaf fall, and occasional mortality. Madrone, bigleaf maple, and the dogwoods seemed to be the most susceptible. Conifers suffered premature needle loss, branch- and top-kill, and death; bark beetles and wood borers frequently attacked the trees. Shoestring root rot will probably infect many drought-weakened trees.

Needle blight of ponderosa pine, caused by *Elytroderma deformans* (Weir) Darker, was common in central Oregon, as it has been for the past 4 years. Spectacular symptoms of the disease were also present on many trees around Republic, Wash.

Larch needle cast, caused by *Hypodermella laricis* Tub., was present in many stands in northeastern Washington. Many of these same trees were also infected by larch needle rust, *Melampsora epitea* Thuem. These diseases were particularly noticeable near Sherman Pass, Wash. Neither disease is expected to be damaging.

Laminated root rot, caused by *Phellinus weirii* (Murr.) Gilbertson (= *Poria weirii* (Murr.) Murr.), is the most damaging root disease in the Pacific Northwest. A survey near Mapleton, Oreg., showed that the disease was present on about 4.7 percent of the forested land. Guidelines for managing this disease have been developed and published in a publication entitled "Laminated Root Rot, A Guide for Reducing and Preventing Losses in Oregon and Washington Forests." Copies are available from the Forest Service, U.S. Department of Agriculture.

Shoestring root rot, caused by *Armillariella mellea* (Vahl ex Fr.) Karst). (= *Armillaria mellea* (Vahl ex Fr.) Kumm.), is the most common root disease of forest trees in Oregon and Washington. The disease causes considerable damage in some eastside stands. Infection in the large Glenwood, Wash., disease complex is more extensive than previously believed. Another large area of infection was found along Klamath Lake and south of Crater Lake. Shoestring root rot is usually not serious on the westside, but it has recently been found to cause significant damage in Douglas-fir plantations near Quilcene, Wash. About half of the 42 plantations surveyed in this area had suffered mortality from shoestring root rot. Tree killing seems to occur in plantations 10- to 30-years-old. The number of trees killed by shoestring root rot will probably increase in 1978 in response to moisture stress.

Southern Region (R-8) and Southeastern Area

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Conditions in Brief

Southern pine beetle infestations decreased to the lowest intensity in several years in the South, except for areas in east Texas and Mississippi.

Increased outbreaks of pine engravers and the black turpentine beetle occurred throughout the Southern Region, but were unusually intense in Texas, Oklahoma, Mississippi, Louisiana, and Arkansas.

Seed and cone insect damage to southern pine seed orchards increased during 1977.

Hardwood insect defoliation declined during 1977. The poplar tentmaker completely defoliated 20,000 acres of cottonwood in west-central Mississippi. A few male gypsy moths were captured in pheromone traps in Virginia, Tennessee, and the Outer Banks of North Carolina. The forest tent caterpillar defoliated large areas of water tupelo in Alabama and Louisiana for the second consecutive year.

New infestations of the fall cankerworm were detected along the Blue Ridge Parkway and in the Pisgah National Forest, N.C., and existing infestations expanded in the Chattahoochee National Forest, Ga., and in the Nantahala National Forest, N.C.

Balsam woolly aphids killed Fraser firs at the same intensity as in 1976. The only Fraser fir type free of this insect is in the Mt. Rogers area of Virginia.

Fusiform rust is a serious problem affecting the management of loblolly and slash pine in the South, but the amount of infection in nurseries was relatively low this year.

Annosus root rot caused damage in a loblolly pine seed orchard in eastern Tennessee.

Pitch canker was a problem in both loblolly and slash pine seed orchards in several States. The disease appears to be declining in Florida.

Charcoal or black root rot caused severe damage to southern pine seedlings in State and industry nurseries in Georgia, Florida, and Alabama. Phytophthora root rot caused significant damage to Fraser fir in a nursery. Cylindrocladium root rot caused severe damage to black walnut seedlings in Kentucky and South Carolina State nurseries.

Status of Insects

Southern pine beetle, *Dendroctonus frontalis* Zimm. Tree mortality from this insect decreased throughout most of Region 8, except in Texas and Mississippi. The Texas Forest Service reported 4,505 groups of dying trees in 36 of the 44 counties in east Texas. Almost 670 of these groups were in Hardin County. Severe southern pine beetle infestations also were detected in Liberty, Montgomery, Jasper, Polk, Shelby, and Orange Counties. About 57 percent of the losses were on industrial lands and 43 percent were on private individual holdings. On National Forest lands, southern pine beetle outbreaks decreased markedly from last year. Salvage logging removed 14.8 million board feet of sawtimber and 4,970 cords of pulpwood on Federal lands and 52.8 million board feet of sawtimber and 41,558 cords of pulpwood on private east Texas lands.

The Mississippi State Forestry Commission reported additional southern pine beetle infestations in 33 counties throughout northeastern and southeastern portions of the State for the second consecutive year. Infestations expanded into Grenada, Yalobusha, Panola, Pike, Tallahatchie, and Walthall Counties and intensified in the Bienville National Forest, and Ackerman Unit of the Tombigbee National Forest. The infestations on the Homochitto and Chickasawhay Divisions of the De-Soto National Forest was slightly less intense than last year. Salvage of beetle-infested trees on private individual and industrial lands exceeded 333,000 board feet of sawtimber and 2,108 cords of pulpwood. On National Forest lands, salvage amounted to 8.1 million board feet of sawtimber and 7,077 cords of pulpwood. In addition, 5,859 infested trees on Federal lands were sprayed with Lindane mixed with water.

In Arkansas, 44 percent of the counties with susceptible pine forest reported light to moderate southern pine beetle infestations. These are located across the lower third of the State. Southern pine mortality was

F—700486
Woodpeckers help control southern pine beetle populations.

Map 4—*Distribution of the southern pine beetle, 1977.*

detected for the first time in Montgomery County. Large-scale tree mortality was reported in Clark and Hot Spring Counties. Salvage of beetle infested trees on nonfederal land within the State amounted to 49.5 million board feet of sawtimber and 15,733 cords of pulpwood. Southern pine beetle suppression was conducted for the first time on the Caddo and Mena Ranger Districts of the Ouachita National Forest. More than 39,900 board feet of sawtimber and 44 cords of pulpwood were salvaged on these Districts in 1977.

Southern pine beetle infestations decreased in the southeastern Oklahoma Counties of McCurtain, Pushmataha, and Choctaw. Most of the infestations reported by the Oklahoma Division of Forestry were on Weyerhaeuser lands and on the Oklahoma Wildlife Preserve and Wilderness Area. The number of infestations on the Tiak Division of the Ouachita National Forest declined from last year. Salvage of beetle-infested trees exceeded 225,000 board feet of sawtimber and 97 cords of pulpwood on private and industrial holdings and 449,000 board feet of sawtimber and 197 cords of pulpwood on the Ouachita National Forest. In addition, 3,255 infested trees on the forest were sprayed with Lindane mixed with water.

In 37 Louisiana parishes, southern pine beetle infestations remained at low intensities for the second straight year. Most infestations were in the western part of the State. On the Kisatchie National Forest infestations were light to moderate on all Districts. Salvage of infested trees on private and industrial ownerships exceeded 4.6 million board feet of sawtimber and 14,063 cords of pulpwood. Salvage on National Forest lands amounted to 5.1 million board feet of sawtimber and 4,714

cords of pulpwood. On the National Forest, 760 trees were chemically treated with Lindane mixed with water.

Only a few isolated southern pine beetle infestations were detected in Alabama during aerial detection surveys.

A 1-year-old outbreak on the Appalachicola National Forest in Florida was successfully controlled this year by promptly salvaging 1.6 million board feet of sawtimber and 2,057 cords of pulpwood.

A 2-year-old outbreak on the Chickamauga-Chattanooga National Military Park along the Georgia-Tennessee border declined naturally to only a few scattered dying trees. This outbreak killed approximately 60 percent of the pine type on the Park.

Southern pine beetle infestations also declined on the Daniel Boone National Forest, Ky., the Cherokee National Forest, Tenn., and the Pisgah and Uwharrie National Forests, N.C.

Infestations in Georgia have been limited to stands of overmature loblolly and longleaf pine in the southeastern corner of the State.

Pine engravers, *Ips* spp. Mortality of moderate to large numbers of southern pines was reported in Texas, Oklahoma, Louisiana, and Arkansas. The Mississippi Forestry Commission reported extremely intensive tree killing in all but one of their districts.

Many of the pine engraver outbreaks were reportedly associated with large populations of either the southern pine beetle or the black turpentine beetle. Mississippi counties reporting heaviest outbreaks included Kemper, Jasper, and Newton where group-kill averaged 30 to 40 trees. Many slash pine plantations were severely attacked by these beetles on the Chickasawhay Division of the DeSoto National Forest, Miss.

In North and South Carolina, most outbreaks occurred on the Coastal Plain and Piedmont Plateau where trees were killed in groups of 10 to 20 with the largest group covering about 2 acres.

Black turpentine beetle, *Dendroctonus terebrans* (Oliv.). Usually large black turpentine beetle infestations occurred in Texas, Louisiana, Oklahoma, Arkansas, and Mississippi. Several of the infestations encompassed groups of 10 to 20 trees. Other infestations were reported on the Bankhead Ranger District, Bankhead National Forest, Ala.

Seedbugs, *Leptoglossus corculus* (Say) and *Tetyra bipunctata* (H.-S.). These insects continue as the most important seed pests of southern pine seed orchards. Empty pine seed averaged 61 percent in untreated areas as compared to 39 percent on trees treated with Guthion® or Furadan® at the Stuart Orchard, La., the Ouachita Orchard, Ark., and the Erambert Orchard, Miss.

Coneworms, *Dioryctria* spp. Damage generally increased in loblolly pine seed orchards during 1977. Cone damage on untreated areas varied from 15.9 percent in the Erambert Seed Orchard, Miss., to 29.0 percent in a forest industry seed orchard in Louisiana. In the Erambert and Stuart Federal Seed Orchards, mature cone damage increased by 6 percent and 10 percent, respectively.

Coneworm damage decreased from 40.9 percent in 1976 to 14.5 percent in 1977 on shortleaf pines in the Ouachita Federal Seed Orchard.

Nantucket pine tip moth, *Rhyacionia frustrana* (Comst.). Cone crop losses in shortleaf pine seed orchards continued. Larvae feed on newly produced conelets and potential cone-producing vegetative tips. The 34.2 percent loss of untreated cones at the Ouachita Federal Seed Orchard was typical. An additional 18 percent of the growing tips on untreated trees in this orchard were damaged. Seed and cone insect damage in the Arkansas Forestry Commission's Seed Orchards was very light.

Forest tent caterpillar, *Malacosoma disstria* Hbn. Continued defoliation to water tupelo in Alabama and Louisiana was detected. About 62,500 acres of this host tree were defoliated in the Mobile and Tensaw River Basins of southwest Alabama. In 1976, more than 90,000 acres of water tupelo were defoliated. In Louisiana, nearly 485,000 acres were defoliated this year as compared to 300,000 acres in 1976. Both States have a history of defoliation by the forest tent caterpillar.

Balsam woolly aphid, *Adelges piceae* (Ratz.). Fraser fir mortality in North Carolina and Tennessee remained at the same level as in previous years. New infestation areas were detected along the Blue Ridge Parkway and in the Great Smoky Mountains National Park. Mt. Rogers, Va., continued as the only uninfested Fraser fir area. North Carolina Christmas tree growers had problems this year with balsam woolly aphids in their plantations. Chemical suppression activities were

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True fir infested with the balsam woolly aphid.

conducted on Roan Mountain (Toecane Ranger District, Pisgah National Forest, N.C.).

Gypsy moth, *Lymantria dispar* (L.). Pheromone trapping of male moths in Virginia, Tennessee, Kentucky, and North Carolina continued in an attempt to detect infestations. Most of the 15 male moths captured in North Carolina were from the Outer Banks. An intensive egg mass survey has been planned for this winter to determine if the moth is established there. An egg mass survey will also be made in Loudoun and Matthews Counties, Va., where previous trapping indicated possible infestations.

In Tennessee, 245 pheromone traps caught only one male moth, while in Kentucky 310 traps failed to capture any males.

Fall cankerworm, *Alsophila pometaria* (Harr.). One thousand acres of intense defoliation were detected along the Blue Ridge Parkway near Asheville, N.C. Defoliation was moderate on 200 acres near the Cradle of Forestry on the Pisgah National Forest. Defoliation on the Chattahoochee National Forest, Ga., and the Nantahala National Forest, N.C., continued to expand.

Defoliation on the Brasstown Ranger District, Chattahoochee National Forest, covered 50,000 acres. On the Wayah, Cheoah, and Tusquitee Ranger Districts, Nantahala National Forest, 20,000 acres were defoliated. Although the trees have been completely defoliated over much of the same area for the last 3 years, no mortality has been reported. Populations of the fall cankerworm egg parasite, *Telenomus alsophilae* Vier., increased in all infestations, but have not yet reached high enough levels to significantly reduce cankerworm populations.

Other Insects (R-8)

Insect	Host(s)	Localities	Remarks
A cone midge *Cecidomyia* n. sp.	Slash pine	Nassau County, Fla., seed orchard	Damaging 1st and 2d year cones
A sweetgum defoliator *Paectes albrostoloides* (Guenee)	Sweetgum	Mississippi, Alabama Georgia, and Louisiana	Scattered defoliation over several thousand acres
Pinkstriped oakworm *Anisota virginiensis* (Drury)	Deciduous trees	Delta National Forest, Miss.	Moderate to severe defoliation on 60,000 acres
Orangestriped oakworm *Anisota senatoria* (J.E. Smith)			
Poplar tentmaker *Ichthyura inclusa Hbn.*	Cottonwood varieties	West-central, Mississippi	Total defoliation of 20,000 acres in plantations
Walkingstick *Diapheromera femorata* (Say)	Deciduous trees	Ouachita National Forest, Ark.	Widespread, light to moderate defoliation
Beech blight aphid *Prociphilus imbricator* (Fitch)	American elm	Lost Valley and Leatherwood, Buffalo National River, Ark.	Low to moderate populations
Elm lace bug *Corythuca ulmi* O. & D.	American elm	Buffalo Point, Buffalo National River, Ark.	Localized complete defoliation
Loblolly pine sawfly *Neodriprion taedae linearis* Ross	Loblolly pine	Calhoun County, Ark.	Low populations
Blackheaded pine sawfly *Neodiprion excitans* Rohw.	Loblolly pine	Columbus, Miss.	Light to moderate defoliation on 32,000 acres
A slug sawfly *Caliroa* sp.	Oaks	Eastern Kentucky	Defoliation evident on 263,000 acres

Map 5—*Distribution of fusiform rust, 1977.*

Status of Diseases

Fusiform rust, caused by *Cronartium fusiforme* Hedgc. and Hunt, remained the most significant disease problem affecting loblolly and slash pine management in the Southeast. Heavy losses in young plantations have resulted in stand abandonment or costly replanting.

In 1974, 14 loblolly pine plantations in South Carolina were selected for study to determine the trend of the disease. After three growing seasons, there was a 22 to 35 percent decrease in the number of healthy trees in plantations now age 4, 5, and 6 years. The number of healthy stems in plantations now age 8 and 13 decreased between 1 and 13 percent.

A study of slash pine in central Louisiana, begun at the same time, revealed 13 to 16 percent mortality in what is now 4-, 8-, and 13-year-old plantations. Mean annual increase in mortality ranged from 1.6 to 4.3 percent in what is now 4-, 5-, 6-, 8-, 13-, and 18-year-old plantations after three growing seasons. Mortality from all causes reached 36 percent in the 4-year-old plantations.

Fusiform rust damage was relatively light (2 to 3 percent) in southern nurseries. This was apparently the result of intensive spray programs and the abnormally hot and dry weather during the spring and summer.

The Fusiform Rust Resistance Screening Center at Bent Creek, N.C., evaluated the rust resistance of loblolly and slash pines of 478 seedlots for both research and operational tree improvement programs.

Comandra blister rust, caused by *Cronartium comandrae* Pk., was found for the first time in 1962 in Arkansas on the Buffalo Ranger District of the Ozark National Forest. It was affecting direct-seeded shortleaf pine. In April 1968, a survey showed that the disease was present in all Districts of the Ozark National Forest. Nineteen percent of all shortleaf pine stands surveyed, 10 years old and younger, were infected.

Some of these areas were checked in May 1977, and apparently the disease is not a serious problem. The alternate host, toadflax, was still growing in some places on the Buffalo Ranger District, but no pines were found with new infections.

Pitch canker, caused by *Fusarium moniliforme* var. *subglutinans* Wr. & Reink. (= *F. lateritium* f. sp. *pini* (Nees) Hepting), was present in several slash and loblolly pine seed orchards. A recent survey of slash pine seed orchards in Florida showed the disease to be present in 22 of the 25 orchards. In two loblolly pine seed orchards, pitch canker symptoms were present on more than 50 percent of the trees.

Pitch canker has also been found in seed orchards in Louisiana and Mississippi. The disease appears to be affecting only individual clones.

No trees have died in these areas. The pitch canker fungus has also been isolated from loblolly pine cones from one Alabama seed orchard.

Pitch canker is a major problem on south Florida slash pine, but the disease is declining throughout its Florida range. As a result of the 1976 epidemic, many research projects were begun to study fungus biology, vector possibilities, disease impact, and control methods.

Annosus root rot, caused by *Fomitopsis annosa* (Fr.) Karst. (= *Fomes annosus* (Fr.) Cke.), is a major problem for forest managers in the South. Concern of 20 years ago that this disease would cause losses that increased geometrically with each thinning is declining. However, severe losses continue on high hazard sites.

Annosus root rot is causing damage at the Hiwassee Land Company's loblolly pine seed orchard in eastern Tennessee. The disease was first found in 1971 and has since killed 2 percent of the trees. Fruiting bodies have been found at the base of more than 6 percent of the remaining trees.

Red-brown butt rot, caused by (*Phoeolus schweinitzii* (Fr.) Pat. (= *Polyporus schweinitzii* Fr.), was found on 38 of the 1,300 trees in the Hiwassee Land Company's loblolly pine seed orchard.

Charcoal or **black root rot,** caused by *Macrophomina phaseoli* (Maubl.) Ashby (= *Sclerotium bataticola* Taub.) and *Fusarium* spp., caused severe losses in State and industry nurseries in South Carolina, Georgia, Florida, and Alabama. These fungi were isolated from 25 percent of both symtomatic (dying tops) and nonsymptomatic loblolly, slash, and sand pine seedlings. In addition, over 200,00 *phaseoli* propagules per gram of soil were isolated. More than 50 percent mortality occurred in field plantings in Florida. Evaluations, in cooperation with the Southeastern Forest Experiment Station and State and industry cooperators, will be used to determine the impact of this disease on seedling production and field plantings.

A F—700488 B F—700495

Charcoal or blackroot rot symptoms and damage on southern pine seedlings (A), *and healthy seedlings* (B).

Fumigating prior to planting with methyl bromide Dowfume® MC–33 at 350 pounds per acre controlled the disease at the Chiefland, Fla., nursery. About 15 million loblolly, slash, longleaf, and south Florida slash pine seedlings died in 1976, causing a loss of $150,000. Following fumigation in the spring of 1977, no evidence of either the fungus or seedling damage was detected.

Phytophtora root rot, caused by *Phythphthora* spp., caused severe damage to Fraser fir seedlings at the Linville State Nursery in western North Carolina. Root rot has caused perennial damage at this nursery for more than 5 years. Poor drainage and high rainfall favor the buildup and spread of the fungus on Fraser fir seedlings. These conditions also reduced the effectiveness of MC–33 soil fumigation during seedbed preparation. Cooperative evaluations are in progress with the Division of Forestry and the North Carolina State Extension Service to determine the impact of this fungus in Fraser fir Christmas tree plantations in western North Carolina.

Cylindrocladium root rot, caused by *Cylindrocladium scoparium* Morgan and *C. floridanum* Sobers and Seymour, caused severe damage to 1–0 black walnut seedlings at the Kentucky Dam State Nursery in western Kentucky, and the Piedmont, S.C., State Nursery. More than 50 percent of the 1977 walnut crop died in one section of the nursery in Kentucky. Soil fumigation with MC–33 during the fall of 1975 apparently did not control *C. scoparium* in this nursery section. *C. floridanum* was isolated from diseased 1–0 sweetgum roots at West Virginia Paper Company's nursery near Summerville, S.C.

F—700489

Lantern wounds damage trees in campgrounds.

Oak wilt, caused by *Ceratocystis fagacearum* (Bretz) Hunt., has increased slightly in Virginia and North Carolina. Only North Carolina attempted control with Tordon® 101R. This followed a 7-year detection program during which no treatments were applied.

Oak decline. Oak decline was reported in many southern States; and there is continued concern with live oak decline in Texas. A number of fungi have been isolated from these oaks, but the cause has not been determined. Research to determine the causal agent, contributing environmental factors, and control methods is continuing.

Dutch elm disease, caused by *Ceratocystis ulmi* (Buism.) C. Mor., caused problems in Arkansas, Oklahoma, Texas, and Alabama, but no new infected areas were reported.

Sycamore decline, a disease characterized by top dieback, leaf scorch, and in many cases diffuse cankers was evaluated in 38 plantations and 11 natural stands in the South. Few stands had extensive damage. No one species of fungus was isolated consistently from cankered wood. *Ceratocystis fimbriata* Ell. & Halst., one suspected causal fungus, was isolated only from cankers in natural stands. Several anthracnose fungi isolated from buds, twigs, and branches may have contributed to the decline.

The Cooperative National Mycorrhizae Nursery Evaluation, a joint program between State and Private Forestry and the Mycorrhizal Institute in Athens, Ga., studied *Pisolithus tinctorius* (Pers.) Coker and Couch grown in two different laboratories. The inoculum was produced by the Mycorrhizal Institute and Abbott Laboratories of Chicago, Ill. The formation of ectomycorrhizae on feeder roots and the effect on overall seedling quality was evaluated in nursery beds. Growth response will be studied in outplantings. Mycorrhizal formation occurred on nine conifer species in 16 nurseries in 14 States from Virginia to California. Similar results were obtained on 10 conifer species in 5 container seedling evaluations in 5 States. The midseason nursery elevations showed the Athens inoculum to be superior to the Abbott Laboratories inoculum in forming ectomycorrhizae. Abbott reported several production problems that have since been corrected, and the Abbott inoculum is now comparable to the Athens inoculum.

Final results from all of the container studies and most of the bare-root studies will be available in spring 1978. Field plantings of the species in each nursery and container project are planned for late winter and early spring 1977–78. The project will be expanded to the Northeastern, Central, and Northwestern United States in 1978.

Research is in progress at the Mycorrhizal Institute on the role of fungi such as *Endogone* (= *Glomus*) spp. in the formation of endomycorrhizae on southern hardwood species. Nursery and container field evaluations will be made if results of this research show promise.

Tip burn and chlorotic needles typical of oxidant injury occurred on eastern white pine in the southern Appalachians. This year's symptoms were less severe than those of previous years, but many trees with chronic symptoms did not survive severe cold in the winter of 1976–77 and/or the summer drought.

Surveys of several campgrounds showed severe decline of trees within campsites. The most common causes were vandalism, lantern wounds, soil campaction, and injuries resulting from construction and poor tree maintenance. Injuries caused by lanterns ranked second in number only to knife and ax wounds. A brochure, "Trees Need Their Skin Too!," focuses attention on these problems.

Several American beech in the Buffalo River Park Area, Ark., were severely cankered and had heart rot throughout their boles. Several fungi were responsible for the heart rot. These trees had been injured by weather and hikers.

Foliage diseases caused little damage in southern nurseries where protective spray programs were used. The hot, dry growing season may also have contributed to a decline in foliage diseases.

The severe winter of 1976–77 caused injury to many conifer species in the southern Appalachians. Late frosts also caused twig dieback on many hardwood species. Some growth loss may result, but no trees have died in forested areas. Some mortality occurred among shade trees following winter related injuries, late frosts, and summer drought. Maples and oaks were the most severely affected.

Eastern Region (R-9) and Northeastern Area

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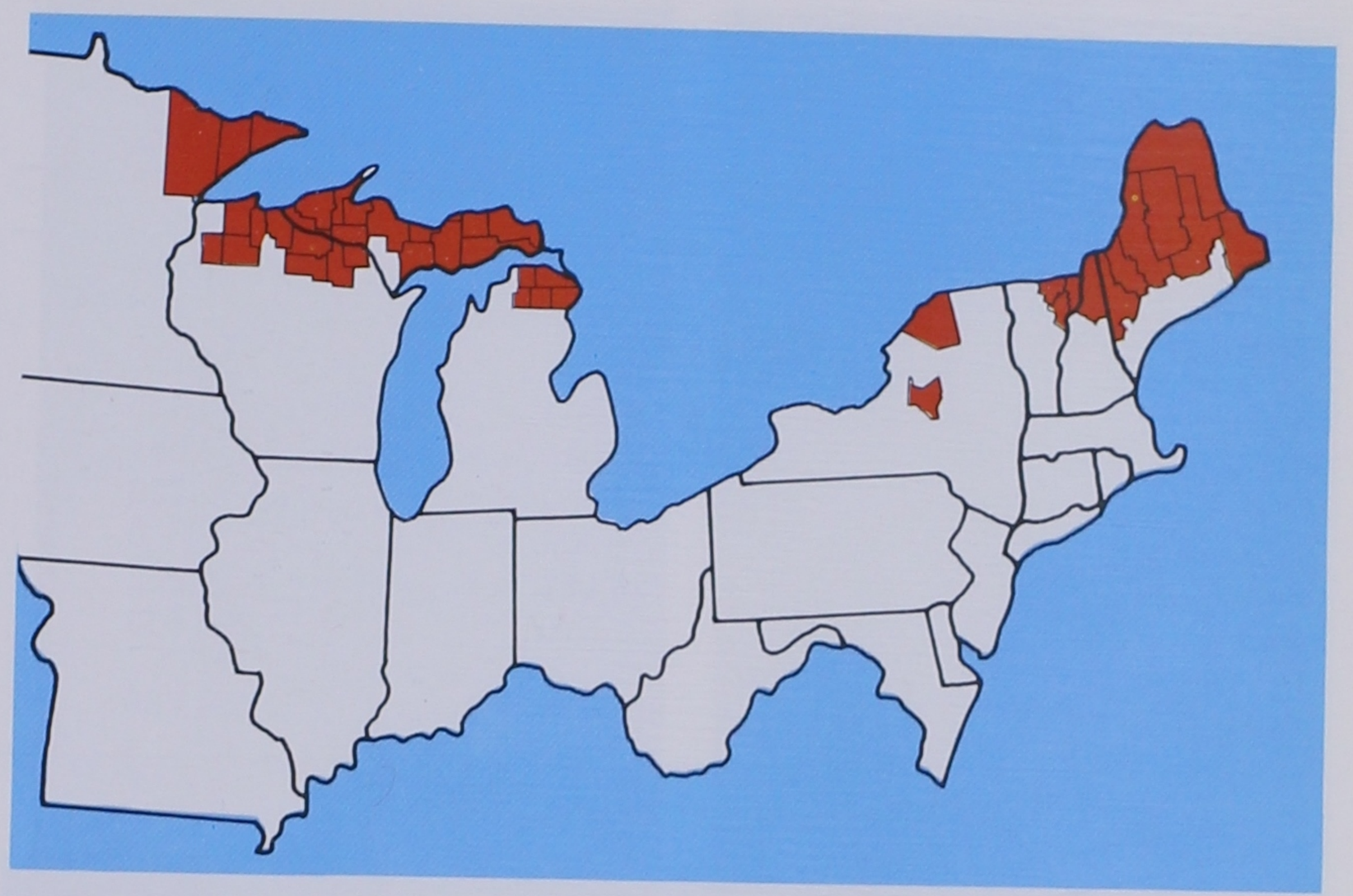
Conditions in Brief

The spruce budworm was the most destructive defoliator of conifers in the 20-State Northeastern Area. Over 10.2 million acres were affected, with Maine experiencing defoliation on 8 million acres. Populations declined in Minnesota, but remained high in Wisconsin and the western portions of the Upper Peninsula of Michigan. Gypsy moth populations increased in Massachusetts, New York, Pennsylvania, and Vermont. About 1.3 million acres were heavily defoliated in Pennsylvania. Forest tent caterpillar populations increased in Michigan, Minnesota, and Vermont defoliating a total of 3.2 million acres. The oak leafroller-oak leaftier complex and saddled prominent defoliated hardwoods on about 2.6 million acres this year.

Dutch elm disease now occurs across the entire Northeastern Area except in the northern counties of Minnesota. Throughout the Northeastern Area, the elm is being eliminated as a shade tree species by Dutch elm disease. Because of this disease, elm is a commercial timber species only in the northern part of the Lake States and Maine. Scleroderris canker continued to be a serious problem in the red and Scots pine plantations in New York and Vermont, where the "European strain" of the fungus is found. Federal and State quarantines are now in effect in these two States to prevent the further artificial spread of the fungus. In the Lake States, scleroderris canker is a pest of smaller plantation trees. Beech bark disease continued to spread slowly across Pennsylvania. In Maine, New Hampshire, and Vermont about 25 percent of the beech has been killed. Ash dieback and butternut decline were common and wide-spread. Drought, winterburn, and wind were the most important abiotic problems in the Northeastern Area in 1977.



Map 6—*Spruce budworm infestations by counties, 1977.*

Status of Insects

Spruce budworm, *Choristoneura fumiferana* (Clem.), a native North American insect, was the most important pest of conifers in the Northeast. Over 10.25 million acres of the spruce-fir type were defoliated, 8.05 million of these acres were in Maine. Recent outbreaks tend to spread eastward, increasing in Ontario and Quebec, then through northern New York, New Hampshire, Maine, New Brunswick, and the Maritime Provinces.

In Maine, about 2 million acres are being considered for treatment in 1978, because populations are heavy and tree mortality is imminent. Aerial damage survey data, biological evaluations, and benefit/cost analyses will influence the final acreage proposed for treatment.

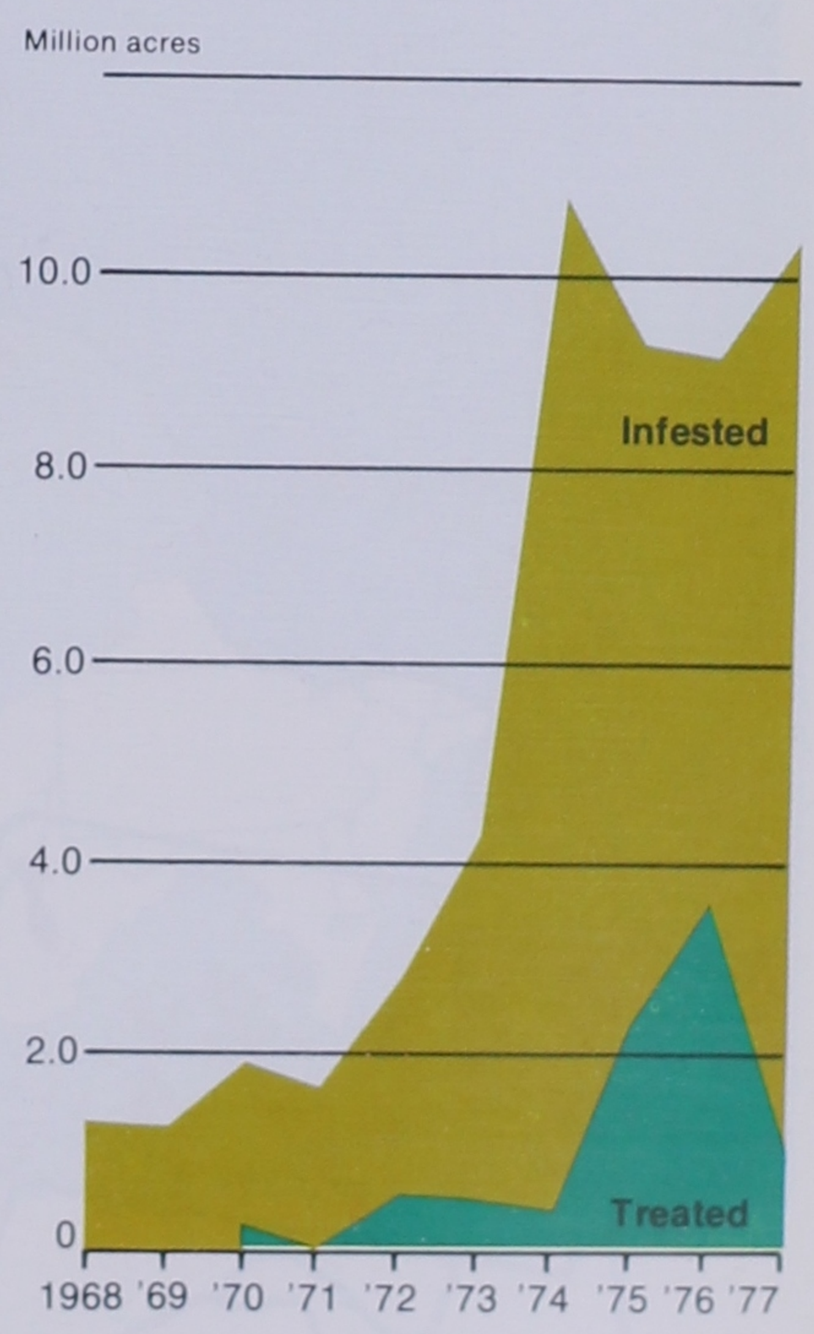


Chart 2—*Trend of spruce budworm infestations and control in the Eastern United States, 1968–77.*

Table 7.—*Area defoliated by gypsy moth in Northeastern States, 1976 and 1977*

(in acres)

State	1976	1977
Maine	0	1,135
New Hampshire	0	320
New Jersey	57,630	39,185
Vermont	3,234	33,435
Massachusetts	29,820	133,081
Rhode Island	7,540	120
Connecticut	9,809	0
New York	26,583	90,963
Pennsylvania	732,310	1,296,550
Total	866,926	1,594,789

Map 7—*Distribution of gypsy moth, 1977.*

Elsewhere in New England, 44,000 acres were moderately to severely defoliated in Vermont. Visible defoliation was found on 110,000 acres in New Hampshire, an increase over 1976. Populations in New York were light over the 250,000 acre spruce-fir type.

Infested acreage in the Lake States totaled 2.2 million acres. Budworm populations declined throughout the Lake States except in northern Wisconsin and adjoining parts of northwestern Michigan. Minnesota reported 900,000 acres were involved in 1977. Defoliation occurred on 150,000 acres, a decrease of 87 percent since 1976. This decline was attributed to adverse weather conditions and to the death of a large portion of the host trees. Nearly 750 million acres of dead balsam fir were detected on the Superior National Forest. Severe defoliation occurred on about 140,000 acres in northeast Wisconsin. Chemical spraying in 1978 is being considered by some industrial landowners in Wisconsin. Populations were high on about 1.16 million acres in the eastern counties of Michigan's Upper Peninsula, but most western counties in this area reported a decrease from 1976.

Gypsy moth, *Lymantria dispar* (L.). About 1.6 million acres of susceptible oak–hickory hardwood type was defoliated by the gypsy moth in 1977, an 84 percent increase over 1976. The extent and severity of defoliation increased significantly in Massachusetts, Pennsylvania, New York, and Vermont. Infestations decreased in Rhode Island and Connecticut.

Pennsylvania reported that six additional counties were affected in 1977 and expects further increases in 1978. About 135,000 acres will be considered for control in 1978.

The dramatic increase in extent and severity of the gypsy moth infestations is likely due to several

conditions. Warm, dry weather in May favored rapid larval development and prevented heavy mortality due to the virus wilt disease. High winds during early larval period spread the young larvae from infested ridges.

Defoliation by the gypsy moth will be heavy and widespread in 1978, particularly on the south and west fronts of the infestation.

Forest tent caterpillar, *Malacosoma disstria* Hbn. The hardwood forests most affected by this insect in 1977 were in the Lake States. Defoliation in northern Michigan increased from 133,000 acres in 1976 to 740,000 acres in 1977. About 2.4 million acres were moderately to heavily defoliated in northern Minnesota. Increased defoliation is expected in both States in 1978.

Three years of defoliation of the oak-hickory forests in south central Indiana have killed nearly 3 million board feet of timber. Thirty-five thousand acres were defoliated in 1977. Heavy parasitism is expected to bring the forest tent caterpillar under control in 1978.

Vermont experienced a dramatic increase in defoliation from 4,500 acres in 1976, to over 31,000 acres in 1977. The prediction for 1978 is a further increase in the area defoliated to as much as 200,000 acres.

A small infestation in Maryland caused defoliation on approximately 2,200 acres for the last 2 years.

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Gypsy moth female, male, pupa, and sixth instar larva.

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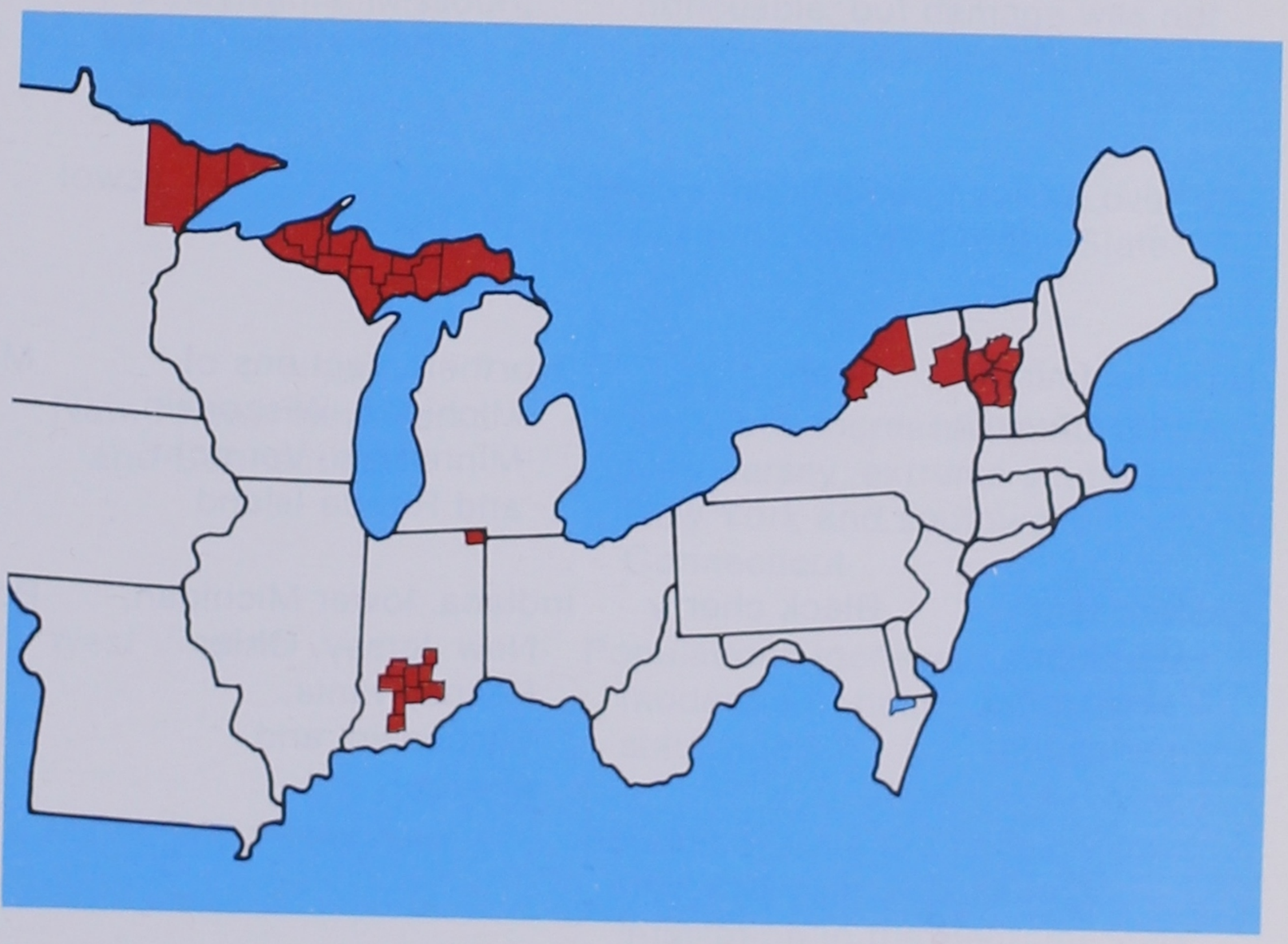
Forest tent caterpillar larvae on a maple.



Map 8—*Forest tent caterpillar infestations by counties, 1977.*

Other Insects (R-9)

Insect	Host(s)	Localities	Remarks
Arborvitae leafminer *Argyresthia thuiella* (Pack.)	White cedar	Lower Peninsula, Mich.	Heavy 1976 population level decreased significantly. The only noticeable defoliation was in Oscoda County.
Asiatic oak weevil *Cyrtepistomus castaneus* (Roel.)	Black, red, white oak, and other hardwoods	Southern Missouri and southeastern West Virginia	Defoliation common but generally light in Missouri. About 1,500 acres were defoliated in West Virginia.
Bagworm *Thridopteryx ephemeraeformis* (Haw.)	Pfitzer evergreen and red cedar	Missouri	Defoliation was moderate to heavy on Pfitzer evergreens and light on native eastern red cedar.
Bark beetles *Dendroctonus* spp. and *Ips* spp.	Pines	Areawide	*Ips* spp. damage was light throughout the Northeast. In Indiana and Ohio, ips attacked pines stressed by winter drying. Ips severely damaged red pine throughout the extreme western Maryland panhandle. Southern pine beetle, *Dendroctonus frontalis*, caused minor damage in Maryland and extreme southern Ohio.
Birch leafminer *Fenusa pusilla* (Lep.)	Birch	Northern sections of Michigan, Wisconsin, Minnesota, Vermont, and Rhode Island	Moderate to heavy defoliation.
Eastern tent caterpillar *Malacosoma americanum* (Fab.)	Black cherry	Indiana, lower Michigan, New Jersey, Ohio, Pennsylvania, Wisconsin, and Missouri	Populations were low in Indiana and Ohio and low to moderate in Missouri. Damage in Pennsylvania increased from 1976 to about 100,000 acres. Populations in Michigan, New Jersey, and Wisconsin were extremely high.

Other Insects (R-9) *(Continued)*

Insect	Host(s)	Localities	Remarks
Fall cankerworm *Alsophila pometaria* (Harr.)	Northern hardwoods	West Virginia, Michigan, New Jersey, Ohio, New York, Massachusetts, Pennsylvania, Vermont, and Rhode Island	Partial defoliation occurred over hundreds of thousands of acres in northern and southeastern Pennsylvania. New York reported moderate to severe defoliation over 33,000 acres. About 500,000 acres were damaged in Massachusetts. Michigan reported localized but severe damage on about 300 acres. Populations in northeast Ohio and the eastern panhandle of West Virginia were low.
Fall webworm *Hyphantria cunea* (Drury)	Various hardwoods	Indiana, New Jersey, Ohio, Massachusetts, New York, New Hampshire, Connecticut, Pennsylvania, Missouri, West Virginia, and Vermont	Damage was severe in northern Indiana, southern Missouri, and central Perry County, Pennsylvania. In Indiana, Ohio, and West Virginia, webbing was noticeable, but damage was not particularly concentrated.
Green fruitworm *Lithophane antennata* (Walk.)	Silver maple	Iowa	Heavy defoliation occurred over the eastern one-third of the State.
Hemlock scale *Abgrallaspis ithacae* (Ferr.)	Hemlock, yews, fir, and spruce	New Jersey, New York, and Connecticut	Infestations increased in northeast New Jersey, extreme southeast New York and southwest Connecticut.
Hickory tussock moth *Halisidota caryae* (Harr.)	Hickory, walnut	West Virginia	Populations increased and caused moderate to heavy defoliation statewide.
Jack pine budworm *Choristoneura pinus* Free.	Jack pine	Minnesota, Wisconsin	Populations are dramatically lower than last year. A 5,000-acre infestation in the Beltrami State Forest of Minnesota collapsed during 1977. About 9,000 acres in northwest Minnesota were lightly defoliated. In Wisconsin, populations were reported as the lowest in 25 years.

Other Insects (R-9) *(Continued)*

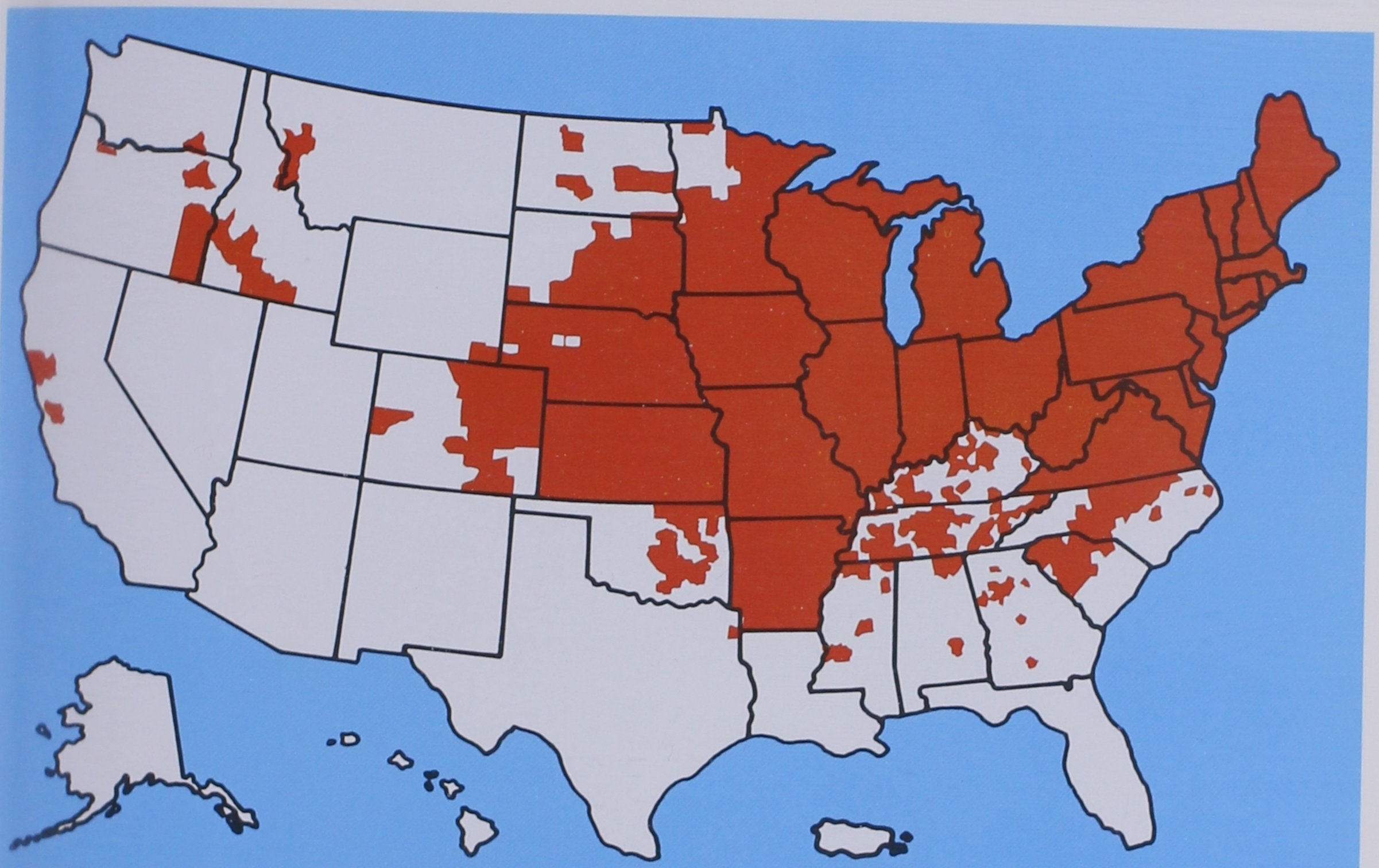
Insect	Host(s)	Localities	Remarks
Larch sawfly (Htg.) *Pristiphora erichsonii*	Larch	Upper Peninsula, Michigan, Massachusetts, New York, Maine, and Vermont	Light to moderate defoliation occurred in the east and moderate to heavy defoliation in the Upper Peninsula of Michigan.
Locust leafminer *Xenochalepus dorsalis* (Thunb.)	Black locust	Indiana, Ohio, West Virginia, Pennsylvania, and Maryland	Widespread defoliation reported in southern and southeastern Indiana; southern, eastern, and central Ohio; southern Pennsylvania; and throughout Maryland. West Virginia also received heavy damage.
Loopers on hemlock *Lambdina* spp.	Hemlock	Upper Peninsula, Michigan, and Pennsylvania	Light to moderate defoliation occurred in Michigan. Mortality reported in eastern Pennsylvania.
Oak leafroller-oak leaftier complex *Croesia albicomana* (Clem.) *Archips semiferanus* (Walk.)	Red oak group	Massachusetts, Michigan, New Jersey, Pennsylvania, and West Virginia	Moderate to heavy defoliation occurred in four states. Massachusetts reported 100,600 acres defoliated by oak leaftier. West Virginia reported 100,000 acres moderately defoliated in the eastern portion of the State by the oak leafroller-oak leaftier complex. Pennsylvania reported only light defoliation.
Oak sawflies *Caliroa* spp.	Oaks	West Virginia, New Jersey	Caused heavy defoliation in 100,000 acres in West Virginia and extensive damage in the northeastern part of New Jersey.
Oak skeletonizer *Bucculatrix ainsliella* Murt.	Oaks	Essex County, Massachusetts	17,000 acres were lightly to moderately defoliated with localized heavy defoliation occurring in portions of the county, causing an esthetic impact.
Orangestriped oakworm *Anisota senatoria* (J.E. Smith)	Oaks	New Jersey	Moderate to heavy defoliation in the central portion of State, but little tree mortality has occurred.

Other Insects (R-9) *(Continued)*

Insect	Host(s)	Localities	Remarks
Pine sawflies *Neodiprion* spp. and *Diprion* spp.	Pines	Indiana, Minnesota, Missouri, and Wisconsin	European pine sawfly caused moderate to severe defoliation of red and Scots pine in northern Indiana and southeastern Wisconsin. Redheaded pine sawfly caused minor damage to red, Jack, shortleaf, and loblolly pine in Missouri. Defoliation of southern pines by loblolly pine sawfly was light in Missouri but severe in some areas of Wisconsin. Scattered, but heavy damage by the introduced pine sawfly occurred on white and Scots pine in Minnesota.
Pine tip moths Zimmerman pine moth *Dioryctria zimmermani* (Grote) nantucket pine tip moth *Rhyacionia frustrana* (Comst.)	Pines	Indiana, Missouri, Pennsylvania, and West Virginia	Local problems in pine plantations.
Pine tussock moth *Dasychira plagiata* (Walk.)	Jack pine, red pine, eastern white pine, spruce, and fir	Minnesota	Populations are light. Extensive and damaging outbreaks have occurred in the past.
Pine weevils, Pales weevil *Hylobius pales* (Herbst) pine root collar weevil *Hylobius radicis* Buch.	Scots pine, eastern white pine, jack pine, blue spruce	Lower Peninsula of Michigan and Pennsylvania	Branch flagging due to pales weevil feeding damaged Christmas tree plantations in the eastern part of the Lower Peninsula of Michigan. Scots pine plantations in the northwest part of the Lower Peninsula, Mich., also being damaged by the pine root collar weevil.

Other Insects (R-9) *(Continued)*

Insect	Host(s)	Localities	Remarks
Red pine scale *Matsucoccus resinosae* Bean & Godwin	Red pine	Connecticut, New York, and New Jersey	Continues to kill red pine in reforested areas of Connecticut and New York. Infestation is spreading north at a rate of 2 to 3 miles per year. New Jersey found only one infestation within their quarantine area, and it was destroyed.
Saddled prominent *Heterocampa guttivitta* (Walk.)	Northern hardwoods	Michigan, Maine, New York, and Vermont	Moderate to heavy defoliation occurred on 35,000 acres in the Upper Peninsula of Michigan with smaller infestations occurring in the northern counties of the Lower Peninsula. In Maine, 35,000 acres were moderately to severely defoliated in 1977. Noticeable beech mortality (10 to 15%) occurred on ridgetop areas defoliated in 1976. Very light defoliation was recorded in both New York and Vermont.
Walkingsticks *Phasmatidae*	Hardwoods, particularly oaks	Maryland, Ohio, and West Virginia	Defoliation occurred on 1,200 acres in western Maryland and eastern West Virginia. Ohio reported severe defoliation in localized areas of southern Ohio.
Walnut caterpillar *Datana integerrima* Grote and Robinson	Hickory and walnut	Indiana, Missouri, and West Virginia	Walnut caterpillar defoliated about 30 percent of black walnut over 1,000 acres in southwest Missouri. In West Virginia, populations are increasing but no large infestations have developed.
White pine cone beetle *Conophthorus coniperda* (Schw.)	White pine	Ohio	Moderate to heavy infestation of white pine cone beetles seriously damaged the 1977 seed crop.
White pine weevil *Pissodes strobi* (Peck)	White pine	New Jersey, Pennsylvania, Vermont, Rhode Island, and Maine	Roadside plantings in Passaic and Morris Counties were damaged by weevils. Pennsylvania reported weevil damage on ornamentals in Monroe County. The insect continues to make white pine planting in Maine a wasted effort in high risk areas.



Map 9—*Distribution of Dutch elm disease, 1977.*

Status of Diseases

Dutch elm disease, caused by *Ceratocystis ulmi* (Buism.) C. Mor., was first described in the Netherlands in 1919 and was introduced into the United States from Europe about 1930. Since that time the disease has spread throughout much of the Eastern United States.

This disease has reduced the urban elm population by about 75 percent throughout the Northeastern Area, except for Minnesota, Wisconsin, and Maine where more than 50 percent of the resource remains.

The greatest economic losses have occurred in urban areas while the largest volume losses occurred in rural environments. Cities with effective sanitation programs have lost about 5 percent of their elms each year. Some cities without effective programs lost more than 60 percent of their elms in 1977. The only alternative available to the rural land manager is salvage.

Dutch elm disease has almost eliminated the use of elms as shade trees in the Northeastern Area and has eliminated elm as a commercial timber species except in the northern parts of the Lake States and Maine.

Scleroderris canker, caused by *Gremmeniella abietina* (Lagerb.) Morelet (= *Scleroderris lagerbergii* Grem.). The "Lake States" strain of *G. abietina* has seriously damaged conifer plantations in North America for many years. It was found in Michigan in 1951 and is currently found in Michigan, Minnesota, New York, and Wisconsin.

The causal fungus, found in New York in 1972, was confirmed as the "European strain" of *G. abietina* in 1974 and confirmed in Vermont in 1977.

The Lake States strain of the disease infects smaller trees and is not usually found over 5 feet above the ground. Trees taller than 6.5 feet are

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American elm infested with Dutch elm disease.

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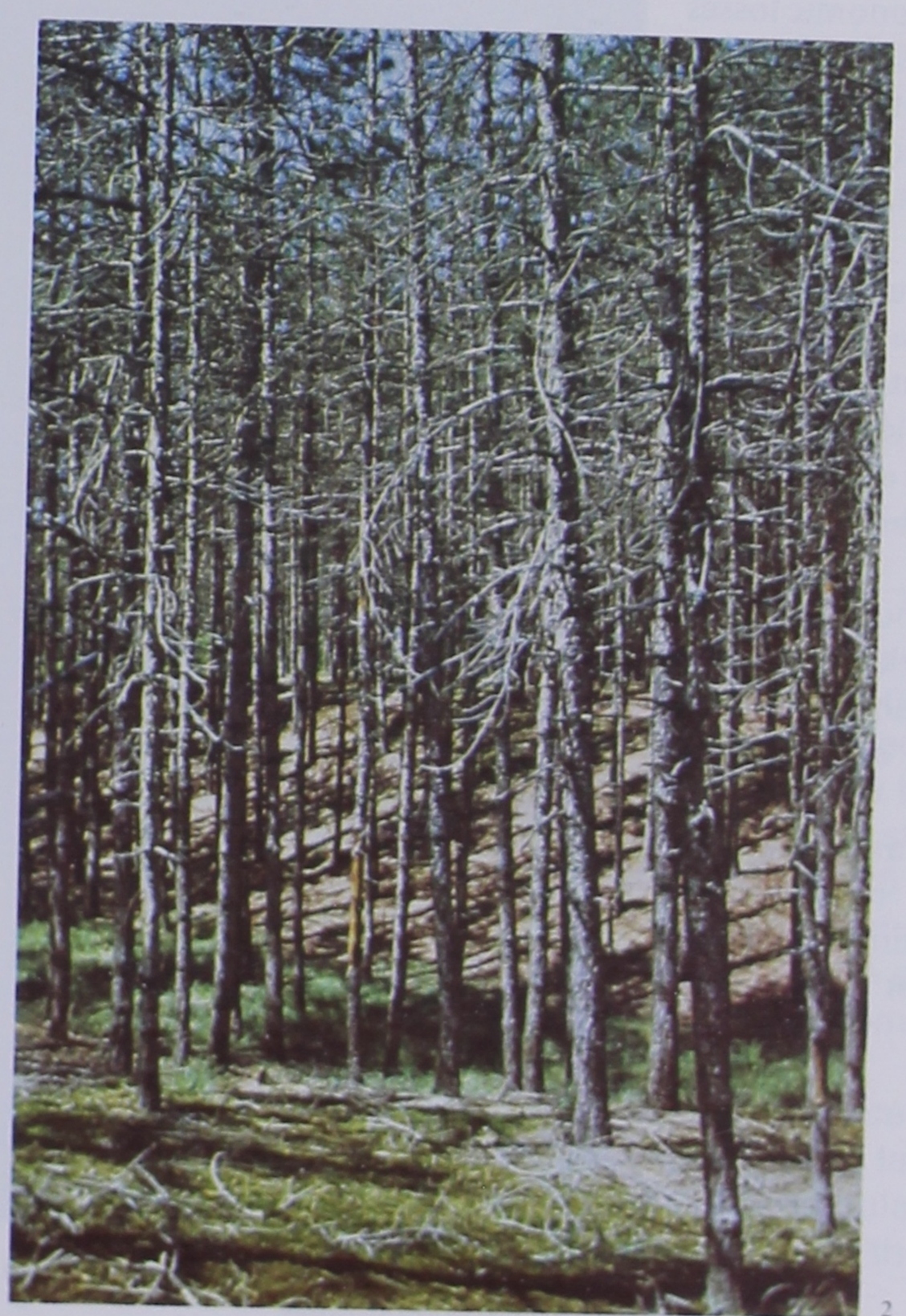
relatively safe from infection or deformation by this strain of the pathogen.

The European strain is not confined to the lower 5-foot area of the tree and causes mortality in all age classes. About 40,000 acres of red and Scots pine are infected in New York. Vermont has about 100 acres infected. In New York the disease did not spread as rapidly in 1976–77 as it did during the 1974–75 season. Scots and red pine reproduction has been virtually eliminated from heavily infected stands. White pine shows symptoms only when it is in the understory of a heavily infected hard-pine stand. Federal and State authorities have imposed a quarantine on Christmas trees from portions of 10 counties in northern New York and 5 counties in Vermont in an effort to minimize artificial spread of the disease.

Beech bark disease, a complex of the small insect *Cryptococcus fagisuga* Lind., and a fungus, *Nectria coccinae* var. *faginata* Loh., Wats.



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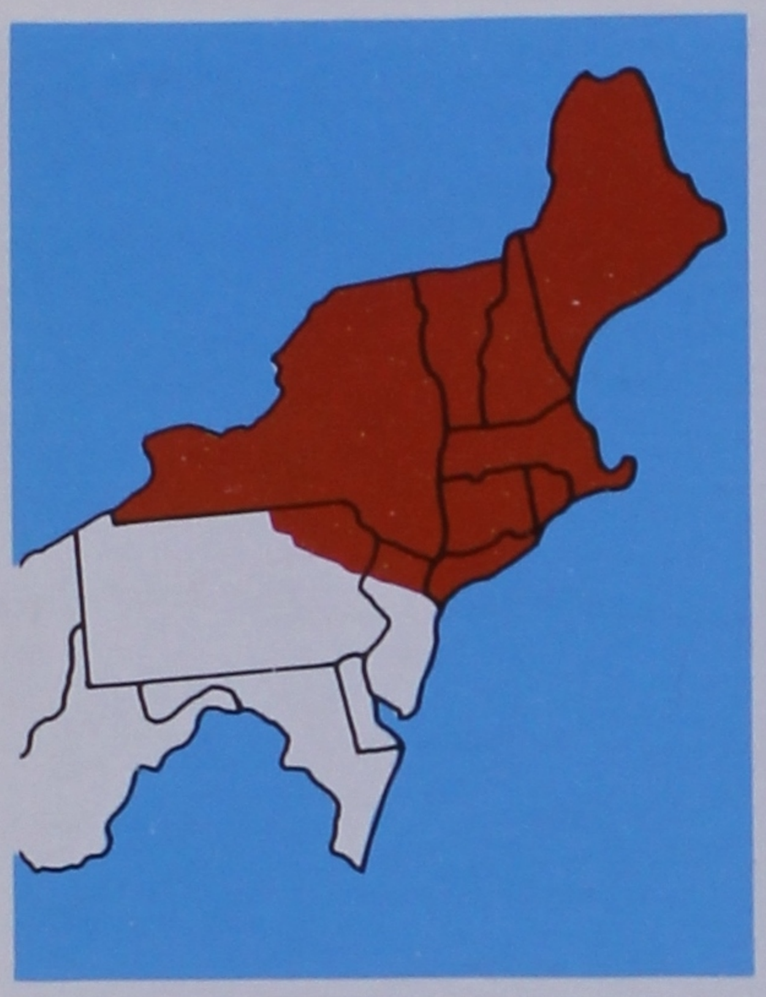
[1] *Young red pines killed by the Lake States strain of scleroderris canker.*

[2] *Large red pines killed by European strain of scleroderris canker, New York.*



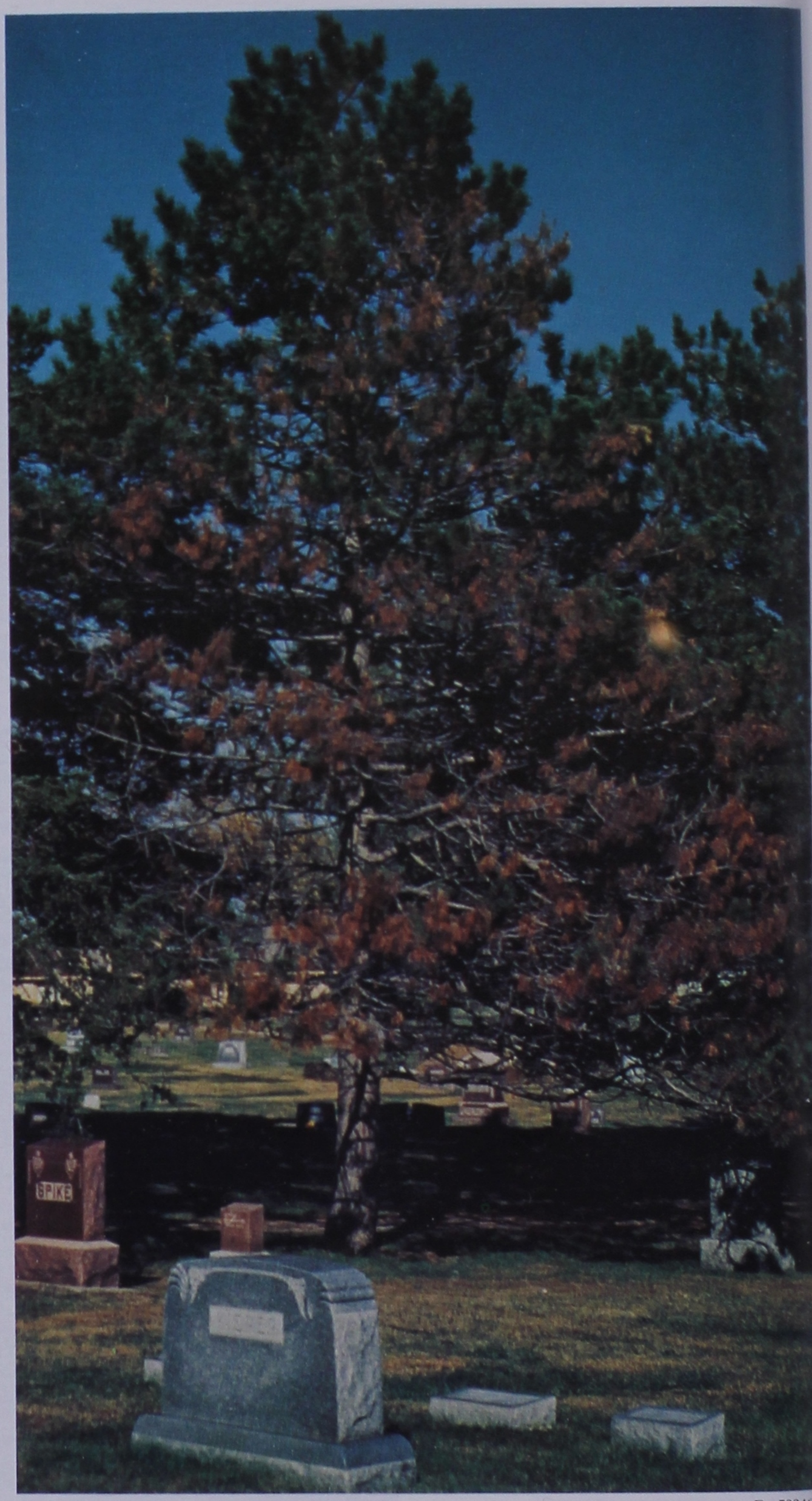
Map 10—*Distribution of beech bark disease, 1977.*

and Ay., has killed about 25 percent of the beech in Maine, New Hampshire, and Vermont. Economic losses are minimal along the southern part of its range. Many of the surviving infected beech are reduced in quality and the species is not favored for regeneration.

A 1977 survey showed a slow but gradual spread south and westward in Pennsylvania at a rate of about 10 miles per year. Low scale populations along the leading edge of the infestation may account for this slow rate of spread.

There are no known control methods for beech bark disease. The only alternatives available to the land manager are salvage and favoring other species.

Whenever the scale and fungus are present in favorable environments they will eventually eliminate beech as a commercial forest tree species.



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Diplodia tip blight damaged plantations and ornamental pines.

Oak mortality (cause unknown) has been noted throughout the Eastern United States. Red oaks seem to be more susceptible than white oaks.

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Other Diseases (R-9)

Disease(s)	Host(s)	Localities	Remarks
Dwarf mistletoe *Arceuthobium pusillum* Pk.	Black spruce	Throughout black spruce range	Fifteen percent of the Lake States stands are infected. Fourteen percent of the infected stands had 50 percent of stems infected, 17 percent had 26 to 50 percent or greater of stems infected and 69 percent of the stands had 25 to 1 percent of stems infected.
Eutypella canker *Eutypella parasitica* Davids. & Lorenz	Sugar maple	Northern part of sugar maple range	Less than 5 percent of the stems are infected. One large area in the upper peninsula of Michigan had 20 percent of the stems infected.

Other Diseases (R-9) *(Continued)*

Disease(s)	Host(s)	Localities	Remarks
Oak mortality (cause unknown)	Oak	Illinois, Minnesota, Missouri, Wisconsin, Pennsylvania, New York, and Indiana	Oak mortality is most damaging on drought-susceptible sites. At least 30,000 acres are affected.
Oak wilt *Ceratocystis fagacearum* (Brentz) Hunt	Oak	Throughout most of the oak range in the Northeastern Area	Oak wilt is endemic throughout its range except for Wisconsin and Minnesota where significant mortality has occurred.
Root rots (nurseries) *Fusarium oxysporium* (Schl.) em. Snyd. Hans. *Sclerotium bataticola* Taub. *Cylindrocladium scoparium* Morg.	Red and white pine	Lake States and Iowa	In many cases entire planting units have been lost. This has reduced planting stock availability and field survival.
Shoestring root rot *Armillariella mellea* (Vahl. ex Fr.) Karst.	All forest species	Northeastern Area	Severe damage in northern Minnesota to red pine following drought.
Sirococcus tip blight *Sirococcus strobilinus* Preuss	Red pine	Lake States, New York, and Maine	Found for the first time in Maine. Occurrence was reduced in Lake States, probably because of the drought.
Sugar maple dieback (cause unknown)	Sugar maple	Pennsylvania	An unidentified canker caused damage to 100 acres.
Sweetfern rust *Cronartium Comptoniae* Arth.	Virginia loblolly pine	Maryland	Ninety percent of the trees on 260 acres are dead or dying.
Verticillium wilt *Verticillium albo-artrum* Reinke & Berth	Maple	Northeastern Area	Noticeable damage to ornamental trees in Iowa, Indiana, and West Virginia.

Other Diseases (R-9) *(Continued)*

Disease(s)	Host(s)	Localities	Remarks
Western gall rust *Peridermium harknessii* J.P. Moore	Scots and Jack pine	Lake States	Scattered pockets of mortality.
White pine root decline *Verticicladiella procera* (Kend.)	White pine	Ohio, Pennsylvania, West Virginia, Indiana, and Maryland	Scattered mortality in planted white pine. About 2 to 3 percent of the trees are lost per year in an infected stand.
Yellow birch canker *Diaporthe alleghaniensis* R.H. Arn.	Yellow birch	Yellow birch range	Primary cause of tree mortality in Region 9's yellow birch tree improvement program. Also causing mortality in nurseries and regeneration areas.
Annosus root rot *Fomitopsis annosa* (Fr. Karst.)	Conifers	Throughout Northeastern Area, except parts of Missouri, Iowa, and Lake States	The most severely affected stands are planted pine on deep sandy soils. Overall, damage is light.
Anthracnose *Gnomonia* sp.	Hardwoods	Iowa	Widespread in Iowa only.
Ash dieback (cause unknown)	Ash	Northeastern United States, plus Ohio and Indiana	About 50 percent of the ash trees are dead or dying within the affected areas.
Balsam fir mortality (cause unknown)	Balsam fir	Northern Minnesota	Severe mortality on sandy soils.
Diplodia tip blight *Diplodia pinea* (Desm.) (Kickx.)	Red, Jack, Scots, Austrian, and ponderosa pine	Throughout Northeastern Area	Severe damage (up to 30 percent mortality) in Wisconsin, Minnesota, and Iowa. Damaged Christmas trees in Michigan and West Virginia with light damage to nursery stock in Indiana. Elsewhere, damage was primarily on ornamental plantings.
Butternut decline *Sirococcus sp.*	Butternut	Throughout butternut range	Southern part of range—90 percent mortality. Middle part of range—70 percent mortality. Northern part of range—no mortality in northern Wisconsin and Minnesota.

Abiotic Problems

Disease(s)	Host(s)	Localities	Remarks
Air pollution	Redbud and white pine	Indiana	Ozone damaged redbud and white pine Christmas trees in southcentral and extreme southern Indiana.
Drought	Variety of forest and shade trees	Lake States, Illinois, Indiana, Iowa, and Missouri	Economic impacts in timber mortality reforestation failures. Esthetic losses were high. Areas were predisposed to attack by secondary insects and diseases. Effects of the 1977 drought will be felt for several years.
Herbicide	Variety of nursery trees	Indiana	Herbicide leached into the irrigation system of the Vallonia Nursery from nearby agricultural fields, damaging newly germinated stock.
Wind	Many species	Wisconsin	About 850,000 acres in northern Wisconsin were damaged by a severe July 4th windstorm. Over 20 percent of this damage was classed as "heavy." An estimated 76 million board feet of sawtimber and 1.4 million cords of pulpwood were affected. Much of this volume is not salvageable. A buildup of insects and diseases may occur.
Winterburn	Many species	Northeastern Area	Winterburn or winter drying was a prominent problem throughout the Northeast and Lake States. Exotic species suffered more than naturally occurring ones. In the Midwest, winterburn predisposed some pine stands to attack by pine engraver beetles. Several nurseries in the Lake States suffered severe damage.

Alaska Region (R-10)

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Conditions in Brief

Abundant bark beetle populations continued to cause the most damage to forested areas in Alaska during 1977.

The spruce beetle killed white spruce on the Chugach National Forest on the Kenai Peninsula and on State lands near Tyonek on the west side of Cook Inlet.

The area of scattered tamarack mortality by the eastern larch beetle expanded between Mount McKinley National Park and Minchumina and Chilchukabena Lakes.

Widespread hardwood defoliation was detected in interior Alaska from leaf beetles and leaf rolling and blotch mining moths. Leaf beetles defoliated large areas of aspen southeast of Fairbanks, Alaska. Leaf rollers defoliated paper birch throughout the Kenai Peninsula and scattered infestations were seen on the west side of Cook Inlet. Blotch miners damaged aspen and alder forests near Fairbanks.

The western black-headed budworm remained endemic in the western hemlock-Sitka spruce forests of southeast Alaska, but larval sampling indicates a local buildup may occur on the northern end of Prince of Wales Island in 1978.

Spruce aphid damage to Sitka spruce was moderate on the Tongass National Forest and severe in residential areas near Sitka, Alaska.

Hemlock dwarf mistletoe, sirococcus shoot blight, and needle rust of western hemlock were the most damaging diseases in southeast Alaska. Siroccocus shoot blight was concentrated in the Thorne Bay area of the Tongass National Forest. A survey of quaking aspen stands in interior Alaska showed that most stands were relatively free of major tree diseases.

F—700497

Fading tamarack killed by the eastern larch beetle, Dendroctonus simplex *LeC., near Mount McKinley National Park, Alaska.*

Status of Insects

Spruce beetle, *Dendroctonus rufipennis* (Kby.). The spruce beetle remained the most damaging forest insect in Alaska in 1977. White spruce damage from this insect on the Chugach National Forest and State lands around Cook Inlet increased from 4,500 acres in 1976 to 12,500 acres in 1977. Since the late 1960's, 550,900 acres have been infested on the Kenai Peninsula and on the west of Cook Inlet. The infestation is now concentrated along the high valued recreation area of Resurrection Creek drainage, Chugach National Forest.

Over the past 10 years, the spruce beetle has killed about 65 percent of the white spruce, 5-inch dbh and larger, in the vicinity of Tyonek, Alaska, on the west side of Cook Inlet. Salvage logging operations on the affected State lands near Tyonek had removed 54.6 million board feet of beetle-killed and susceptible white spruce by August 1977.

Eastern larch beetle, *Dendroctonus simplex* LeC. Eastern larch beetle infestations in the Alaskan interior increased to 532,000 acres from 350,000 acres in 1976. Scattered dying eastern tamarack were typical of the infestation from Minchumina and Chilchukabena Lakes southward to Mt. McKinley National Park. The infestation also extended from the Foraker River eastward across the McKinley River to Moose Creek. The infestation has moved eastward from the upper Kantishia River drainage where it was first detected in 1974. Scattered tamarack mortality also occurred along the Tanana River near Fairbanks. Tamarack stand density is low over most of the infested area, but localized concentrations of fairly dense growth do occur.

Spruce aphid, *Elatobium abietinum* (Wlk.). The spruce aphid damaged Sitka spruce on all areas of the Tongass National Forest, but were most destructive to the older

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White spruce killed by the spruce beetle, Dendroctonus rufipennis *(Kby.), near Tyonek, Alaska.*

spruce along the tidelands for about 20 miles on the southern end of Suewez Island near Ketchikan, Alaska, and for 2.5 miles along Calder Bay on the northern end of Prince of Wales Island. Spruce aphid damage in the Sitkane Area occurred along a mile of shoreline at Pt. Barrier on the southern end of Kupreanof Island and in scattered pockets on Monte Carolo Island and the surrounding smaller islands near Sitka, Alaska. Population increases were probably due to the mild winter of 1976.

Western blackheaded-budworm, *Acleris gloverana* (Wals.). This potentially destructive defoliator remained at a low density in the western hemlock-Sitka spruce forests of southeastern Alaska for the second consecutive year. August larval sampling from 82 permanent plots throughout the Tongass National Forest indicated endemic populations, but two plots, Calder Bay and Tuxekan, had higher larval counts indicating a possible budworm buildup on the northwest portion of the Prince of Wales Island in 1978.

Other Insects (R-10)

Insect	Host(s)	Localities	Remarks
Spear-marked black moth *Rheumaptera hastata* (L.)	Paper birch	Kanai Peninsula	Scattered light defoliation
Leaf rollers *Epinotia* spp. *Archips* spp.	Paper birch	Vicinity of Trapper Joe, Longmat, and Fustumena Lakes, Kenai Peninsula	Severely defoliated 46,400 acres
		Vicinity of Long and Red Shirt Lakes, west side of Cook Inlet	Severely defoliated 5,600 acres
Aspen blotch miner *Lithocolletis ontario* (Free.)	Quaking aspen	Fairbanks	516,000 acres severely defoliated
Alder blotch miner *Lithocolletis* sp.	Alder	Fairbanks	Local, severe defoliation
Leaf beetle *Chrysomela* sp.	Black cottonwood	Gilbey River Canyon near Juneau	Moderately defoliated 640 acres
Leaf beetle *Chrysomela* sp.	Quaking aspen	Between Delta Junction and Tok, southeast of Fairbanks	Moderately defoliated 100,000 acres
Hemlock sawfly *Neodiprion tsugae* Midd.	Western hemlock	Ward Creek Canyon, north of Ketchikan	Low population densities

Status of Diseases

An extensive survey of quaking aspen diseases was made along the roads of southcentral and interior Alaska in cooperation with Forest Disease Research (Rocky Mountain Forest and Range Experiment Station). Additional collections were made with the aid of Forest Survey personnel (Forestry Science Laboratory, Juneau) in the Porcupine-Upper Yukon area.

Canker causing fungi, *Cryptosphaeria populina* (Pers.) Sacc., *Cenangium singulure* (Rehm) Davidson and Cash, *Ceratocystis frimbriata* Ell. and Halst., and *Cytospora chrysosperma* Per. ex Fr., were common in most stands. *Ceratocystis alba* Devay and Davidson was collected near Palmer and *C. crassivaginata* Griffin was found at Moose Lake northwest of Fort Yukon.

Phellinus tremulae (Bond). Bond and Boris was the most common decay fungus in all of the stands examined. *Cryptochate rufa* (Fr.) Boidin was found near Fairbanks, Tok, Coopers Landing, and Chandalar Creek. *Ganoderma applanatum* (Pers. ex Wallr.) Pat. was collected at Mile 1236 Alaska Highway. *Pholiota aurivella* (Fr.) Kumm. was common in overmature mixed hardwood stands near Fairbanks. An *Armillariella mella* (Vahl ex Fr.) Karst. (= *armillaria mellea* (Vahl ex Fr.) Kumm.) center was found in a "poor site" stand on the Bonanza Creek Experimental Forest and at a campground near Tok.

A leaf and top dieback fungus, *Pollaccia radiosa* (Lib.) Bald. and Cif. was found on 2- to 4-foot tall reproduction on the Willow Experiment Forest near Palmer. *Rhytidella baranyay* Funk and Zalasky and *Curcurbitaria staphula* Dearn., two fungi causing rough-bark, were found at Cooper Landing and Fairbanks, respectively.

During the course of the survey both mixed and pure balsam poplar stands were examined and the following were found: *Cryptosphaeria populina* from the Bonanza Creek Experimental Forest, Cooper Landing, and at Mile 122 on the Richardson Highway, and *Cenangium populneum* (Pers.) Rehm from Talkeetna.

With the exception of the mixed stands in the Bonanza Creek Experimental Forest, most aspen stands were healthy. Bonanza Creek stands are overmature and decadent.

The canker and rough-bark fungi were causing only minimal losses. The leaf and top dieback fungi have the potential to cause serious damage to reproduction but are not doing so now.

The *A. mellea* damage in the Tok campground followed trunk and root damage caused by campers. The tree loss within this campground will continue until the stems and roots of the remaining trees are protected from injury.

Hemlock dwarf mistletoe, *Arceuthobium tsugense* (Rosend.). G.N. Jones, was controlled on two of the three areas of the Tongass National Forest. A contract was awarded for the removal of residual trees on 1,200 acres of recently logged stands on the Stikine area. Tree removal was completed on 700 of the 1,200 acres by October 1. On the Chatham area, a contract was awarded for 476 acres of dwarf mistletoe control. All work was completed and another contract was awarded for dwarf mistletoe control on 500 acres for 1978.

Hemlock needle rust, caused by *Pucciniastrum vaccinii* (Wint.) Joerst., occurred in an unusually heavy infection on reproduction at Thomas Bay near Petersburg. From a distance, the affected reproduction looked orange. This rust attacks current year needles and at times the cone scales. Normally, little damage is done, but some growth loss or mortality may occur from this outbreak. The heavy infection may have been due to last summer's dry weather.

Siroccocus tip blight, *Siroccocus strobilinus* Preuss., is common as far north as Yakutat. However, the blight is not causing damage except near Thomas Bay, where it is causing abnormal terminal and lateral shoot growth on western hemlock.

A study of the disease at Thomas Bay was completed and the report will be available soon. The current disease severity in potential crop trees is no cause for alarm.

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